

Appendix G

HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:

Mid-Columbia Coho Reintroduction
Feasibility Project

**Species or
Hatchery Stock:**

Coho salmon (*Oncorhynchus kisutch*)

Agency/Operator:

Yakama Nation/Washington Department of
Fish and Wildlife

Watershed and Region:

Wenatchee, Methow, Entiat basins

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HATCHERY AND GENETICS MANAGEMENT PLAN

MID-COLUMBIA COHO REINTRODUCTION FEASIBILITY PROJECT

December 2002

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SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of Program: Mid-Columbia Coho Reintroduction Feasibility Project (Project #9604000)

1.2) Population (or stock) and species: Coho Salmon (*Oncorhynchus kisutch*), currently extirpated in mid-Columbia basins.

1.3) Responsible organizations and individuals:

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Other organizations involved, and extent of involvement in the program:

Technical Work Group (TWG) Members:

- Bonneville Power Administration (BPA) (also is primary funding agency)
- Confederated Tribes of the Colville Indian Reservation
- National Marine Fisheries Service (NMFS) (NOAA Fisheries) (also has decision responsibilities for listed species)
- Northwest Power Planning Council (NPPC) (also makes Fish and Wildlife Program decisions under the Northwest Power Act)
- U.S. Fish and Wildlife Service (USFWS) (also has decision responsibilities for listed species)
- U.S. Forest Service (USFS) (also has decision responsibilities for facilities located on USFS land)
- Chelan Public Utility District (also owns and funds operation of some facilities used by the project)

1.4) Funding source: Bonneville Power Administration

Staffing level: 14 FTEs

Annual hatchery program operational costs: \$802,000 (does not include planning/design, construction, or monitoring/evaluation)

Entire project budget: \$2,200,000

1.5) Location(s) of hatchery and associated facilities:

Location of program: Feasibility phase (what this HGMP covers—see section 1.7.2): Wenatchee, Methow, and Entiat river basins in Washington State. See Figure 1.

Facilities that would be used (see figures 1-3):

This project is a feasibility study (see section 1.7). As such, it must rely on existing or temporary facilities. Most existing facilities are programmed for other species as their first priority. As a result, when needs change in the priority program, the coho feasibility project must find another site. Since the coho program's inception in 1996, sites for most activities have changed, often several times. Until feasibility has been demonstrated and a long-term program is approved (see section 1.11.2), sites likely will continue to change. Listed below are facilities approved or formally proposed as of spring 2002.

1. Broodstock collection: Tumwater, Dryden, or Wells dams; Winthrop National Fish Hatchery (NFH) or Leavenworth NFH (fish ladder or Dam 5); mainstem dams above Priest Rapids; or Prosser Dam on the Yakima River.

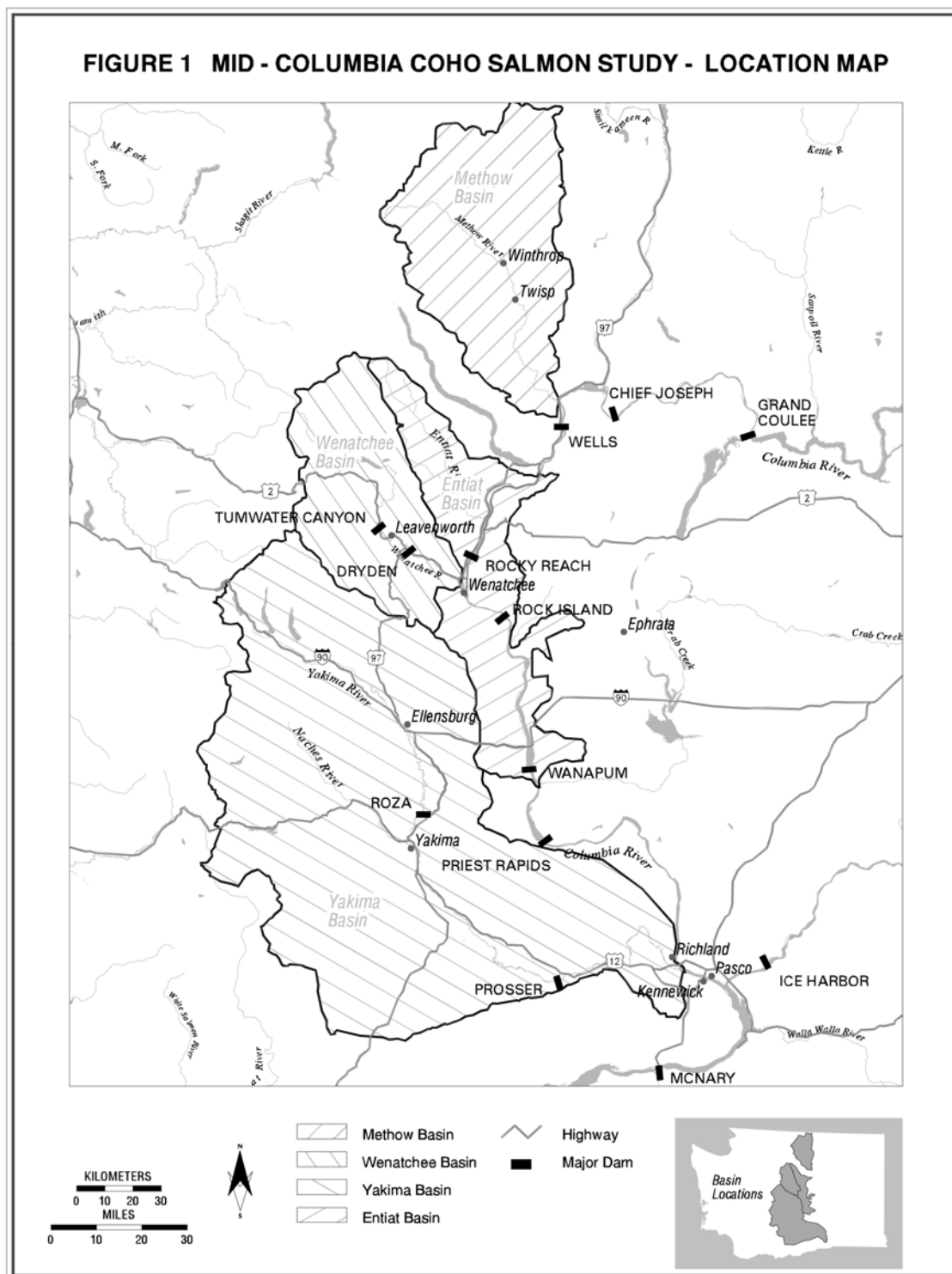
2. Adult holding/spawning: Winthrop NFH will be used for adults returning to the Methow basin. In the Wenatchee basin, the Chiwawa Ponds were used to hold adult coho in 2000 and 2001; the Entiat NFH will be used to hold adult coho in 2002 and beyond.

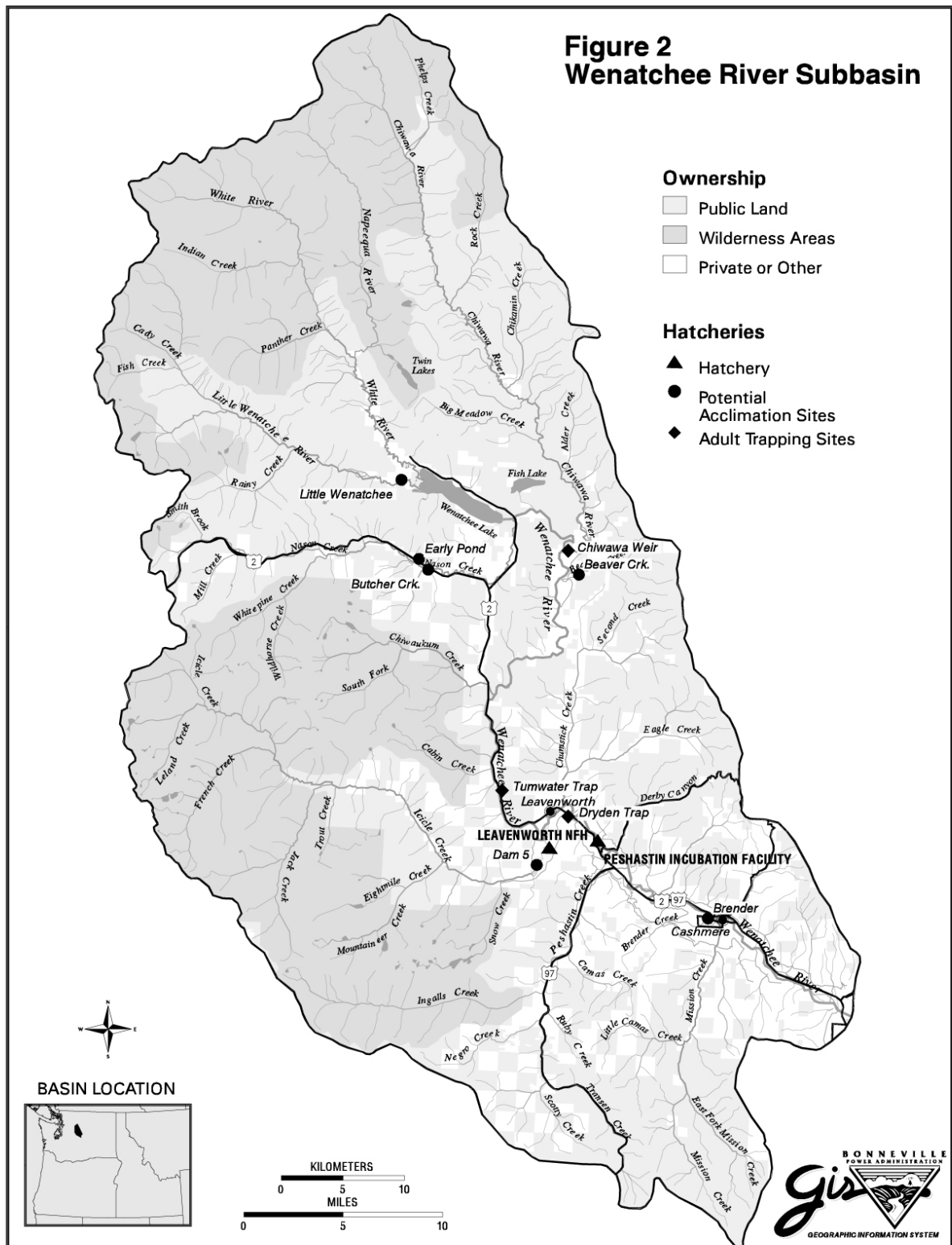
3. Incubation/Early Rearing:

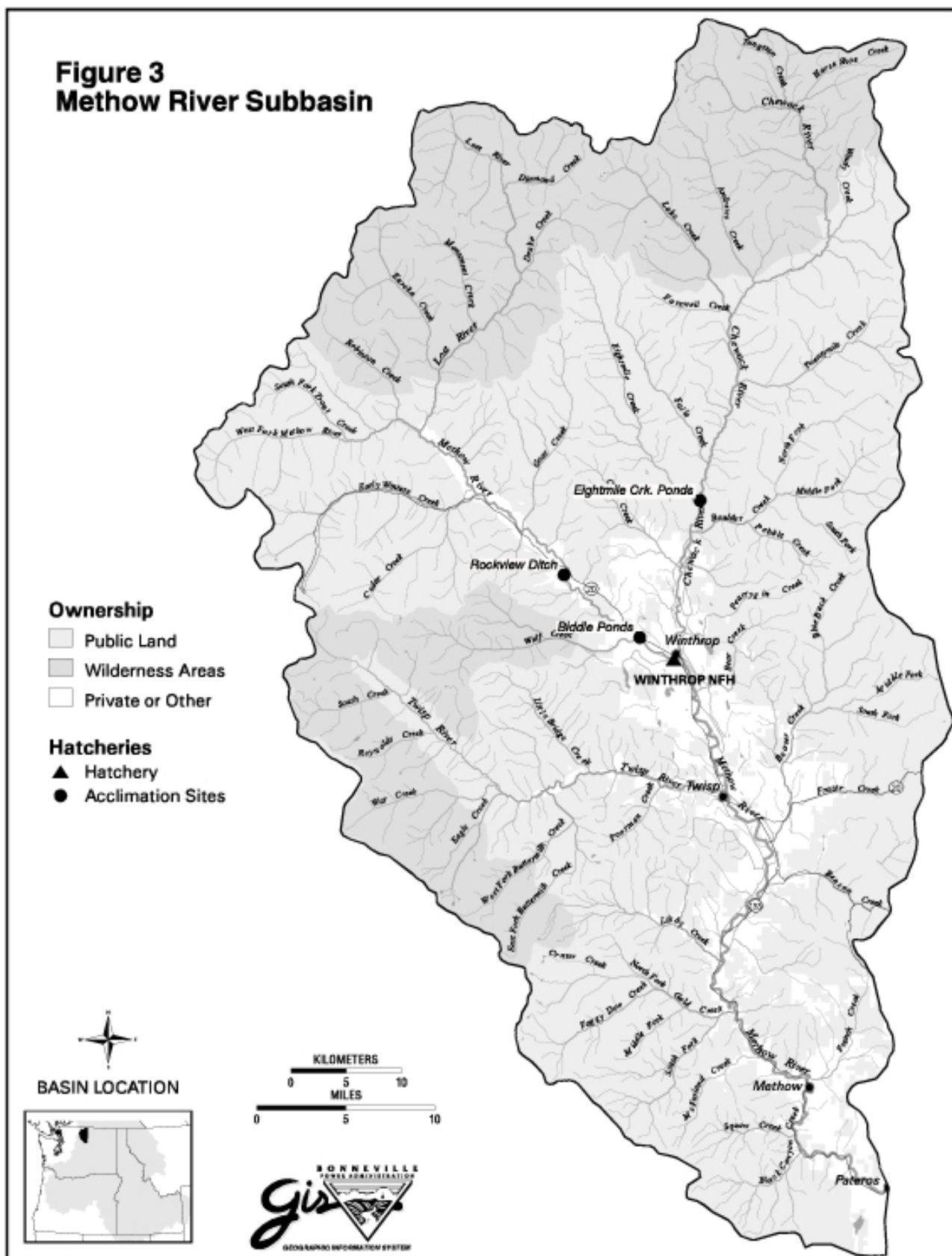
Incubation sites include the following locations in the mid-Columbia region: Peshastin incubation facility, Entiat NFH, Leavenworth NFH, and Winthrop NFH. In the lower Columbia, Cascade Hatchery (ODFW) and Willard NFH are used.

Rearing sites include the following locations: Cascade Hatchery, Willard NFH, and Winthrop NFH. In-basin smolt production could be proposed in the future at an as-yet undetermined location. Options currently identified include Chiwawa, White River, Two Rivers (Little Wenatchee), Leavenworth NFH, Entiat NFH, and Dryden Dam, but others could be identified in the future.

4. Acclimation/release: Figures 2 and 3 show potential locations in the Wenatchee and Methow basins. Some sites shown on the maps, and others that may be proposed in the future, would be reviewed by the TWG and various regulatory agencies, and would be subject to environmental analysis of site-specific impacts. The project might not use every site identified. While specific sites in the Entiat basin have not yet been proposed or identified for this phase of the program, potential streams have (the Entiat and Mad rivers). Section 10 provides further details on sites in the Wenatchee and Methow basins.







5. Other: Monitoring. Locations of various types of monitoring activities are identified briefly below. Section 11 describes the activities in detail.

Wenatchee basin:

- Juvenile out-migration and predation would be monitored using rotary traps located near the mouth of Nason Creek (predation on spring chinook) and at the Lake Wenatchee outfall (predation on sockeye). Weirs could be used on smaller tributaries such as Chumstick, Brender, and Beaver creeks. Alternatively, beach seining, tow-netting, or fyke nets could also be used to collect coho to analyze predation on sockeye.
- Juvenile distribution and abundance would be monitored using systematic snorkel surveys upstream, and especially downstream, of all release sites.
- Juvenile coho in Lake Wenatchee may be radio-tagged to determine their potential overlap with sockeye.
- Surveys using hydro-acoustic, beach seining, trawling, and/or purse seining gear would collect information on age-specific sockeye rearing distribution in Lake Wenatchee.
- If necessary, electro-fishing and/or snorkeling would be done in the following places:
 - 1) for spring chinook and bull trout just below the release site near Lake Wenatchee (Two Rivers); and
 - 2) for spring chinook, steelhead, and naturally spawned coho in Nason Creek.
- PIT tag detection of juvenile coho mainstem survival would be done at existing facilities at Rock Island, McNary, John Day, The Dalles, and Bonneville dams.
- Coded wire tags (CWTs) would be collected from spawned broodstock and from carcasses found during spawning surveys, to estimate smolt-to-adult survival by release group.
- Adults will be monitored at Priest Rapids and Rock Island dams on the Columbia River, at Tumwater and Dryden dams on the Wenatchee, and at the adult broodstock weir on the Chiwawa River. Remote underwater video camera monitoring systems could be installed at some sites.
- Foot/boat redd surveys will be conducted to determine spatial distribution of returning coho adults in potential natural spawning areas including Nason Creek, Beaver Creek, Chumstick Creek, Brender Creek, and the Wenatchee and Little Wenatchee rivers. On smaller tributaries such as Chumstick, Brender, and Beaver creeks, weirs could be used to monitor adult returns.
- Radio telemetry and video monitoring will be used to determine distribution of coho adults returning to the Wenatchee River basin. They could be trapped and radio-tagged at Priest Rapids, Dryden, and/or Tumwater dams.

Methow basin:

- PIT tag detection would be done at the same locations as for Wenatchee fish, with the addition of Rocky Reach Dam.

- Adult monitoring would be done at Wells and Rocky Reach dams to determine conversion rates between dams.
- Juvenile distribution/abundance monitoring would be done using systematic snorkel surveys at all release sites.
- Foot/boat redd surveys along with radio-telemetry techniques may be used to determine the spawning distribution of coho returning to the Methow River basin.

Entiat basin: Locations not proposed at this time.

1.6) Type of program: Integrated Recovery

1.7) Purpose (Goal) of program:

The Mid-Columbia Coho Reintroduction Program encompasses a vision of an optimistic future that may take many years to achieve, as well as short-term goals that will provide information to enable decision-makers to assess whether the vision is achievable. This section has been divided into two parts to describe both long- and short-term (feasibility phase) goals. However, **the remainder of this plan focuses on tasks and impacts related to the short-term goals.** The long-term vision is provided to help reviewers understand the plan's overall context.

1.7.1) Long-term Vision

The long-term vision for this program is to reestablish naturally reproducing coho salmon populations in mid-Columbia river basins, with numbers at or near carrying capacity, that provide opportunities for significant harvest for Tribal and non-Tribal fishers.

The Yakama Nation believes that achieving this vision will be possible only with continued regional efforts to improve habitat for all anadromous species. Until significant improvements are made in conditions such as mainstem passage or agricultural water use, the mid-Columbia coho program, like other salmon programs in the Columbia basin, probably will need to supplement a locally adapted population for many years.

The vision is closely tied to the vision for reintroduction of coho to the Yakima basin and to other areas from which the species has been eliminated. Mid-Columbia coho reintroduction is identified as a priority in the *Wy-Kan-Ush-Mi-Wa-Kish-Wit* document (Tribal Restoration Plan) by the four Columbia River Treaty Tribes, and has been affirmed as a priority by the Northwest Power Planning Council (see section 3.2).

Mid-Columbia basins historically occupied by coho include the Wenatchee, Methow, Entiat, and Okanogan basins. Mullan (1983) estimated historical mid-Columbia River adult coho populations as follows:

- Wenatchee—6,000 - 7,000
- Methow—23,000 - 31,000
- Entiat—9,000-13,000
- Okanogan—Numbers were not identified, although their presence was documented

The ideal would be to restore coho populations in these basins to their historical levels. Due to varying degrees of habitat degradation in each of these basins, historical numbers are unlikely ever to be achieved, but remain a goal towards which to strive.

1.7.2) Goals of Feasibility Phase

This phase, which is expected to last at least through 2004, has two primary goals:

- to continue existing studies and to initiate new ones (adapting to changing needs, new information, and concerns of project participants) to determine whether a broodstock can be developed from Lower Columbia River coho stocks, whose progeny can survive in increasing numbers to return as adults to the mid-Columbia region; and
- to initiate natural reproduction in areas of low risk to sensitive species, and in other select areas to study the risks and interactions with sensitive species.

Studies done in this phase will inform future decisions about whether the long-term vision described in 1.7.1 can be achieved.

1.8) Justification for the program

The Mid-Columbia Coho Program is a phased approach to a “Restoration” program as defined in Part II.C of the NPPC’s *Artificial Production Review* (NPPC 1999). This section states: “An extreme case of a restoration production program is where the natural population has been eliminated, and fish are reintroduced by artificial production when the problem causing the extirpation is removed. A restoration program is a temporary measure that will be withdrawn once the natural population is rebuilt or a determination is made that restoration is not possible.” (NPPC 1999, p. 14)

Because there are listed species in this basin that, unlike coho, have not been extirpated, and because barriers to natural production have been reduced (not eliminated), this project is taking a phased approach to restoration by testing the feasibility of developing a naturally reproducing broodstock as well as testing the risks to other species, before implementing a full-scale restoration program.

1.9) Program “Performance Standards”

Specific objective(s) of program (at least through 2004):

Experience with the project so far has shown that trying to define specific numeric goals for such an experimental project is unrealistic. Too little is known at this stage about the possibilities and risks of an attempt to re-establish a new population of formerly extirpated coho. The project has grappled annually with the study results to determine the significance of survival, interactions, and overall program feasibility and has found that annual agreements with the TWG on release numbers and other program specifics are most effective at meeting feasibility study needs. The list below identifies the feasibility study’s objectives.

- Determine whether hatchery adults from lower Columbia River broodstock return in increasing numbers to the Wenatchee and Methow basins so that their progeny may be expected to reach replacement, thus significantly limiting the infusion of the Lower River hatchery stock, with the long-term goal of eliminating use of the Lower River stock altogether.
- Continue to develop a locally adapted broodstock in the Methow and Wenatchee basins.
- Continue coho smolt releases in areas where coho adults will be allowed to return to spawn naturally. These areas currently are expected to be in the Wenatchee basin in

Nason, Beaver, Chumstick, and Brender creeks; and in the lower Wenatchee and Little Wenatchee rivers.

- Evaluate rearing and release procedures within the constraints of hatchery operations that maximize adult survival and the creation of naturally spawning populations.
- Study interactions among coho and listed and sensitive species, particularly spring chinook and sockeye salmon, steelhead, and bull trout. Such studies have required, and could continue to require, coho releases in habitat of sensitive species.
- Minimize potential negative interactions among coho and listed and sensitive species while also conducting necessary interaction studies.
- Annually evaluate project performance with TWG and resource managers and expand or adapt studies as data indicate are necessary or appropriate.
- Monitor hatcheries that raise program coho for compliance with IHOT guidelines.

1.10) List of Performance Indicators designated by "benefits" and "risks"

Monitoring studies of these performance indicators are described in detail in section 11.

1.10.1) Benefits to coho

- Trends in survival of hatchery coho as measured by PIT tags (smolt-to-smolt), and by counts at dams/facilities and CWTs (smolt-to-adult).
- Spatial distribution of returning adults in potential natural spawning areas as identified from radio telemetry, foot/boat redd surveys, and weirs.
- Reproductive success (initial evaluations only) of naturally reproducing coho using redd counts, redd capping, and smolt production estimates.
- Changes made by out-of-basin stock, using genetic monitoring of neutral allelic frequencies; and physical and behavioral traits such as fecundity, body morphometry, maturation timing, and straying and homing to acclimation sites.

Risks to other listed species

- Predation on other species by program fish as indicated by stomach content analyses.
- Superimposition of spring chinook redds by spawning coho as measured by superimposition studies.
- Competition for food and habitat during freshwater rearing of naturally produced coho juveniles as measured through micro-habitat use and growth evaluations.
- Other potential ecological interactions as indicated by residualism studies or by F2 evaluations.

1.11) Expected size of program

1.11.1) Program size for the feasibility stage (this plan)

Table 1 shows smolt release numbers, broodstock requirements, and production so far. Total release numbers in the Wenatchee and Methow basins are defined under agreements as part of *U.S. v. Oregon*. Feasibility studies will identify ecological risks, broodstock requirements, and survival of out-of-basin stocks. Current plans are to release only smolts. In the future, however, if the Technical Work Group determines that study objectives would be better served—for example, in interaction studies—another life stage could be used. Total numbers released in each basin are not expected to change for the feasibility phase, although release sites in each basin could change. Release numbers at each site are evaluated and discussed among TWG members annually as study needs require and as facility availability changes.

1.11.2) Program size in the long term

Before implementation of the long-term vision described in section 1.7.1 can begin, a variety of decision processes must be completed, using the results of the feasibility studies. These processes most likely would include, at a minimum, a National Environmental Policy Act (NEPA) document if federal funding is involved, and a Step Two and Three review by the NPPC. Then, if the decision-making entities agree to continue the project, it is expected that release numbers would be calculated taking into account carrying capacity (see section 3.5.1), survival estimates of hatchery produced and naturally produced coho, harvest goals, and any reductions necessary to limit risks to other species. It is possible, however, that future coho releases would be less than the number required to fully seed the habitat, in order to limit interactions with listed species.

1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.

Program performance is shown in Table 1.

1.13) Date program started: Research into feasibility began in 1996.

1.14) Expected duration of program:

Program staff expect that results from feasibility studies could be sufficient by 2004 to allow managers to recommend options for the long term. While it is likely that some form of long-term program will be recommended, a number of options will need to be developed and considered in a variety of decision processes that could take several years to complete. Coho releases are unlikely to be suspended while these decision processes continue, and some feasibility studies are expected to continue beyond 2004. Such studies could contribute, for example, to NEPA or ESA analyses that would help resource managers determine specifics of a long-term program. Full-scale implementation could begin formally only after the following three conditions are met: a) initial feasibility and evaluation of the most important critical uncertainties related to coho re-introduction have been determined, b) the project co-managers propose such a program, and c) an Environmental Impact Statement (EIS), the NPPC Step Two and Three reviews, and other decision processes are completed, currently expected in approximately 2008.

Table 1. Summary of Coho Releases and Broodstock Development

Table 1a. Methow Basin Coho Program									
Smolt Releases									
Smolt Release Year	Winthrop	Total	All progeny derived from adults returning to the Methow will be released into the Methow basin unless the Wenatchee basin is short of local brood fish. In that case, Winthrop production would be released in the Wenatchee basin. See section 10.4 for detailed guidelines on source of releases.						
1998	341,000	341,000							
1999	0	0							
2000	200,000	200,000							
2001	180,000	180,000							
2002	200,000	200,000							
2003	250,000	250,000							
2004	250,000	250,000							
2005	250,000	250,000							
Winthrop Adult Returns					Smolt Production from Methow Returns				
Adult Return Year	Adult Re-returns***	Prespawn Mortality	Broodstock	Natural Spawning****	Females	Spawning Year	Eggs	Smolts	Outplant Year
1999	0*	0	0	0	0	1999	204,000	145,000	2001
2000	0*	0	0	0	0	2000	0	0	2002
2001	536*	54	334	202	93	2001	239,000	165,000	2003
2002**	209	21	130	58	0	2002	175,000	124,000	2004
2003-2005	TBD	TBD	TBD	TBD	TBD	2003	TBD	TBD	2005
<p>* Actual observed numbers</p> <p>** Adjusted for relatively poor downstream survival rates (9.9%) in 2001</p> <p>*** Smolt-adult survival for 2001 (only year so far with returns): 0.17 – 0.27% (TWG meeting notes, 1/29/02)</p> <p>**** This natural spawning is predicted as a result of capture efficiency at Wells and straying</p>									

1.15) Watersheds targeted by the program:**Short-term (this plan)**

Wenatchee: Nason Creek, Wenatchee River, Little Wenatchee River, Icicle Creek, Chumstick Creek, Brender Creek, Beaver Creek

Methow: Methow River. In the first few years of this project, we released fish from sites on the Chewuch River (Eightmile and Fulton Ditch) and Wolf Creek (Biddle Pond).

Longer-term vision

Ideally, coho would be re-established into all suitable habitat in mid-Columbia basins and tributaries. Likely areas include:

Wenatchee: All streams targeted in the feasibility phase, plus White River, Chiwawa River, Peshastin Creek

Methow: In addition to Methow River, Chewuch River, Wolf Creek, Twisp River, Eight Mile Creek

Entiat: Entiat River, Mad River

Okanogan: Okanogan River and tributaries

1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.

When BPA evaluated the proposed feasibility studies in its Environmental Assessment (EA) (USDOE BPA 1999b), it considered three alternatives to the program proposed by the Yakama Nation (the “Tribal Alternative”). The three alternatives to the proposal were: “Phased Study Alternative,” which would have funded research in the Wenatchee basin only; “Hatchery Releases Alternative,” in which the only question studied would have been whether adult coho could return in sufficient numbers to replace themselves, with no predation studies, and no acclimation or spawning in natural habitat; and “No Action Alternative,” which anticipated continued releases of coho in the mid-Columbia region under *U.S. v. Oregon* but without BPA funding and with little or no research. The “Tribal Alternative” was selected as the proposed action because it best met the needs and purposes outlined in the EA (USDOE BPA 1999b, sections 1.1 and 1.2) and was found to have no significant environmental impacts. The December 1999 HGMP outlined the Tribal Alternative in as much detail as was possible at the time. Since then, the program has been modified in certain details, which are presented in this update, but the fundamental goals have not changed.

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS

2.1) List all ESA permits or authorizations in hand for the hatchery program.

- NMFS Biological Opinion, April 27, 1999 specifies terms and conditions for project studies for one year. This Opinion required preparation of a long-term management plan, which resulted in the 1999 HGMP (NMFS 1999(b)).
- USFWS Biological Opinion 01-F-E0231, May 18, 2001 specifies terms and conditions to minimize incidental take of bull trout, including requirements for electro-fishing (USDI, FWS 2001).
- WDFW Section 10 Permit #1094. Coho broodstock collection is done in conjunction with WDFW steelhead broodstock collection under this permit. Under Modification 2 of this permit, radio tagging coho adults at Priest Rapids Dam is done in conjunction with WDFW adult steelhead radio tagging (NMFS 1998(b)).
- WDFW Section 10 Permit #1203. Coho smolt trapping for predation studies in the Wenatchee basin is done in conjunction with WDFW juvenile salmonid research under this permit.

2.2) Provide descriptions, status, and projected take actions and levels for ESA-listed natural populations in the target area.

2.2.1) Description of ESA-listed salmonid population(s) affected by the program.

- Identify the ESA-listed population(s) that will be directly affected by the program.
(Includes listed fish used in supplementation programs or other programs that involve integration of a listed natural population.)

No listed species will be directly affected by the program. The program's target species is coho salmon, which has been extirpated from mid-Columbia basins and is not listed under ESA.

- Identify the ESA-listed population(s) that may be incidentally affected by the program.

(Includes ESA-listed fish in target hatchery fish release, adult return, and broodstock collection areas).

Information in this section includes status of species and potential impacts in the Entiat basin, as well as in the Wenatchee and Methow basins, although the project does not propose coho releases in the Entiat at this time. The information is offered to give reviewers a context for the long-term plans and to show similarities and differences among the basins in this region. As well, the information could be useful should adaptive management reviews suggest that studies or other work be undertaken in a basin other than those currently proposed.

Table 2. ESA-Listed Fish Species in the Wenatchee and Methow Basins

Common Name	Endangered Species Act	Washington Species Criteria
Spring chinook salmon (Upper Columbia River)	Endangered	Vulnerable/Species of Importance
Steelhead trout (Upper Columbia River)	Endangered	Species of Importance
Bull trout	Threatened	Vulnerable/Species of Importance

Table 3 lists spawning areas for listed species that are within 8 km (5 mi) of potential coho acclimation sites in the Wenatchee and Methow basins. Although not ESA-listed, sockeye and summer chinook are included in the tables and some of the analyses. Lake Wenatchee sockeye are one of only two sockeye populations remaining in the Columbia River system, and summer chinook are important because, though presently healthy, only a few historically numerous populations still exist in the Columbia River basin. Please see figures 2 and 3 for approved or proposed acclimation site locations as of spring 2002. Other known spawning areas in the two basins that are more than 8 km from acclimation sites are listed by species and stream below the table. Specific acclimation/release sites have not yet been proposed for the Entiat basin.

Table 3. Spawning Areas for Sensitive Anadromous Species Near Potential Coho Acclimation/Release Sites*

Basin/Water Body	Spring chinook	Summer chinook	Sockeye	Steelhead	Bull trout
Wenatchee					
Nason Cr.	X			X	U
Little Wenatchee R.	X		X	X	U
Wenatchee R. mainstem	X	X		X	
White R.	X		X	X	X
Chiwawa R.	X			X	X
Icicle Cr.				X	U
Beaver Cr.				X	
Brender Cr.				X	
Chumstick Cr.				X	
Methow					
Upper Methow R.	X			X	U
Methow R. mainstem	X			X	
Twisp R.	X			X	U
Chewuch R.	X			X	U
Wolf Cr.	X			X	U
Goat Cr.				U	

*Legend: X = spawning area overlaps with coho acclimation site

U = spawning area is no further than 8 km (5 mi) upstream of acclimation site

The following lists known spawning areas for listed species in addition to the streams listed in Table 3; they are all more than 8 km (5 mi) from coho acclimation and release sites evaluated for this project.

- **Spring chinook:** Methow basin—Lost River
- **Steelhead:** Wenatchee basin—Mission Creek, Peshastin Creek
Methow basin—Gold Creek, Libby Creek, Beaver Creek, Early Winters Creek, Lost River
- **Bull trout:** Wenatchee basin—Ingalls Creek, Chiwaukum Creek, Mill Creek (tributary to Nason), White River, Panther Creek (tributary to White R.), Chickamin Creek, Rock Creek, Phelps Creek, Icicle Creek (resident population)
Methow basin—Foggy Dew Creek, Crater Creek, Buttermilk Creek, Reynolds Creek, Blue Buck Creek, Lake Creek, Goat Creek, Early Winters Creek, Cedar Creek, West Fork Methow River, Monument Creek, Lost River

Although potential acclimation and release sites have not been proposed in the Entiat basin, streams most likely to be targeted initially for coho reintroduction (should the long-term vision be implemented) would be the Entiat and Mad rivers. These streams are known to contain the following listed species (USDA FS 1996):

- **Spring chinook:** Lower Entiat, Lower-Mid Entiat (stronghold*), Upper-Mid Entiat, Lower and Middle Mad rivers.
- **Steelhead:** All of the Entiat except Upper; and Middle Mad rivers.
- **Bull trout:** Lower Entiat, Lower-Mid Entiat, Upper-Mid Entiat (stronghold*), all Mad River (stronghold).
- **Late-run chinook:** Lower Entiat, Lower-Mid Entiat (stronghold*), Upper-Mid Entiat.

* (as indicated in USDA FS 1996)

Table 4 shows the temporal overlap of life-history stages for species in these basins. Adult steelhead migrate at similar times to coho. They, like coho, are collected for broodstock at Dryden and Tumwater dams in the Wenatchee basin and at Wells Dam on the mainstem Columbia River. They may migrate up Icicle Creek to Leavenworth NFH, although none have been observed at the trap. Adult bull trout also could be in these broodstock collection areas. Spring chinook would not be affected at trapping sites because they pass these areas in May and June.

Table 4. Life History Timing of Methow and Wenatchee Salmonids

Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chinook (Spring)	Adult Immigration												
	Adult Holding												
	Spawning												
	Incubation												
	Emergence												
	Rearing												
	Juvenile Emigration												
Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chinook (Summer)	Adult Immigration												
	Adult Holding												
	Spawning												
	Incubation												
	Emergence												
	Rearing												
	Juvenile Emigration												
Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chinook (Fall)	Adult Immigration												
	Adult Holding												
	Spawning												
	Incubation												
	Emergence												
	Rearing												
	Juvenile Emigration												
Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sockeye	Adult Immigration												
	Adult Holding												
	Spawning												
	Incubation												
	Emergence												
	Rearing												
	Juvenile Emigration												
Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Coho	Adult Immigration												
	Adult Holding												
	Spawning												
	Incubation												
	Emergence												
	Rearing												
	Juvenile Emigration												
Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Steelhead (Summer)	Adult Immigration												
	Adult Holding												
	Spawning												
	Incubation												
	Emergence												
	Rearing												
	Juvenile Emigration												
Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bull Trout	Spawning												
	Incubation												
	Emergence												
	Rearing												

2.2.2) Status of ESA-listed salmonid population(s) affected by the program.

- Describe the status of the listed natural population(s) relative to “critical” and “viable” population thresholds (*see definitions in “Attachment 1”*).
- Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.
- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.
- Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

The following is a brief review of listed fish status in each basin, based on material already published, as noted. WDFW is developing HGMPs for all listed fish in mid-Columbia basins under the jurisdiction of the Mid-Columbia Habitat Conservation Plan (part of the re-licensing process for the mid-Columbia public utility districts). When completed, those documents will have the most up-to-date status of and plans for the listed fish.

UCR Spring Chinook

In general, recent total abundance of Upper Columbia River spring chinook has been quite low (NMFS 1999(a)). Spring chinook run estimates 1986 – 1998 for the Wenatchee, Methow, and Entiat basins are shown in tables 5 – 7 below.

Table 5. Run Estimates, Wenatchee River Spring Chinook

Year	Rock Island Dam Count	Rocky Reach Dam Count	Wenatchee Redd Counts
1986	21,001	4,138	441
1987	18,883	3,480	545
1988	16,212	4,823	491
1989	10,690	3,168	493
1990	7,721	1,909	446
1991	5,781	1,323	251
1992	15,634	2,714	491
1993	19,943	4,128	536
1994	2,041	349	125
1995	887	256	23
1996	2,150	569	72
1997	6,205	1,866	175
1998	3,324	842	78

Source: NMFS 1999(a)

Table 6. Run Estimates, Methow River Spring Chinook

Year	Wells Dam Count	Methow River System Redd Counts
1986	2,896	186
1987	2,272	673
1988	3,024	733
1989	1,633	517
1990	967	482
1991	687	250
1992	1,542	738
1993	2,601	647
1994	258	133
1995	82	15
1996	387	0*
1997	971	145
1998	406	0*

*All fish collected at Wells Dam.

Source: NMFS 1999(a)

Table 7. Run Estimates, Entiat River Spring Chinook

Year	Rocky Reach Dam Count	Wells Dam Count	Wenatchee Redd Counts
1986	4,138	2,896	105
1987	3,480	2,272	64
1988	4,823	3,024	67
1989	3,168	1,633	37
1990	1,909	967	83
1991	1,323	687	32
1992	2,714	1,542	42
1993	4,128	2,601	100
1994	349	258	24
1995	256	82	1
1996	569	387	8
1997	1,866	971	20
1998	842	406	15

Source: NMFS 1999(a)

UCR Steelhead

The following information on UCR steelhead is taken entirely from NMFS 1999(a).

The life history of this ESU is similar to other inland steelhead ESUs. However, smolt ages are some of the oldest on the west coast (up to 7 years old), likely as a result of the

ubiquitous cold water temperatures (Mullan et al. 1992). Adults of this ESU spawn later than most downstream populations. Adults of Wenatchee and Entiat River populations return after one year in the ocean, those from the Methow River primarily after two years of ocean life. Adults remain in fresh water up to a year before spawning.

The entire ESU has been heavily hatchery-influenced, with a thorough mixing of stocks as a result of the Grand Coulee Fish Maintenance Project beginning in the 1940s (Fish and Hanavan 1948; Mullan et al. 1992). Until recently, hatchery releases composed of a composite of basin stocks continued. The Wells Hatchery stock is included in the listing. Currently, efforts are underway to develop hatchery programs from more locally adapted stocks, using naturally spawning fish.

Most natural production occurs in the Wenatchee River watershed and in the Methow/Okanogan river systems, with a small run returning to the Entiat River. A majority of fish spawning in natural production areas are of hatchery origin. Indications are that natural populations in the Wenatchee, Methow/Okanogan, and Entiat rivers are not currently self-sustaining.

In recent years it was determined that steelhead habitat in the upper Columbia region was over-seeded, primarily due to the presence of hatchery fish; on the average, hatchery seeding was nearly 110% of the level of production the habitat could support. In addition, it was estimated that the proportion of hatchery-origin steelhead in spawning escapements was 65% in the Wenatchee River and 81% in the Okanogan, and Methow rivers (Busby et al. 1996), a level much higher than that NMFS believes is acceptable to minimize adverse genetic effects to natural populations. This is likely a partial explanation for the low natural replacement rates estimated for the area; populations in the Wenatchee River have a recent Natural Cohort Replacement Rate of 0.3, while those in the Entiat River are no greater than 0.25 (Bugert 1997).

Table 8 shows steelhead counts at mid-Columbia dams. Table 9 shows seeding levels relative to capacity for the Wenatchee, Methow, and Entiat basins.

Table 8. Steelhead Counts at Mid-Columbia Dams

Year	Priest Rapids Dam Count Wild Origin		Rock Island Dam Count	Rocky Reach Dam Count	Wells Dam Count
1986	22,382	2,342	22,867	15,193	13,234
1987	14,265	4,058	12,706	7,172	5,195
1988	10,208	2,670	9,358	5,678	4,415
1989	10,667	2,685	9,351	6,119	4,608
1990	7,830	1,585	6,936	5,014	3,819
1991	14,027	2,799	11,018	7,741	7,715
1992	14,208	1,618	12,398	7,457	7,120
1993	5,455	890	4,591	2,815	2,400
1994	6,707	855	5,618	2,823	2,138
1995	4,373	993	4,070	1,719	946
1996	8,376	843	7,305	5,774	4,127

1997	8,948	785	7,726	7,726	4,107
1998	5,790	919	4,810	4,265	2,482

Source: NMFS 1999(a)

Table 9. Estimated Steelhead Smolt Production Capacities

Watershed	Smolt Production Capacity	Recent Ten-Year Seeding Levels	Seeding Levels' Percent of Production Capacity
Wenatchee	62,167	73,371	118.2%
Methow	58,552	65,586	112.0%
Entiat	12,739	10,728	84.2%
Total	133,458	149,685	

Source: NMFS 1999(a)

Bull Trout

The following information is taken entirely from USDI FWS 2001.

The mid-Columbia River region includes watersheds of four major tributaries of the Columbia River in Washington. USFWS identified 16 bull trout subpopulations in the four watersheds (number of subpopulations in each watershed)—Yakima River (8), Wenatchee River (3), Methow River (4), Entiat River (1) (USDI FWS 2001).

Bull trout in this region are most abundant in Rimrock Lake of the Yakima River basin and Lake Wenatchee of the Wenatchee River basin. Both subpopulations are considered “strong” and increasing or stable. The remaining 14 subpopulations are relatively low in abundance, exhibit “depressed” or unknown trends, and primarily have a single life-history form. USFWS considers 10 of the 16 subpopulations at risk of extirpation because of naturally occurring events due to isolation, single life-history form and spawning area, and low abundance (USDI FWS 1998).

Wenatchee River basin. USFWS identified three bull trout subpopulations in the Wenatchee River basin: 1) Lake Wenatchee, 2) Icicle Creek, and 3) Ingalls Creek. In 1995, the Chelan County Public Utility District video-recorded 15 bull trout ascending Tumwater Dam. Although migratory (fluvial) and possibly resident bull trout are present, USFWS believes that the majority of bull trout upstream of Tumwater are migratory (adfluvial) and use Lake Wenatchee.

Of the three subpopulations, the Lake Wenatchee subpopulation has the greatest number of fish in the Wenatchee basin (Brown 1992; K. Williams, WDFW, *in litt.* 1996; A. Murdoch, WDFW, *in litt.* 1997). Anecdotal accounts indicate that the Little Wenatchee River and tributaries to Lake Wenatchee once supported a popular bull trout fishery (WDFW 1997). The bull trout spawning in the Little Wenatchee River basin was last recorded in 1984, and this stock may be extirpated (WDFW 1997). Bull trout have been extirpated from the Napeequa River, a tributary to Lake Wenatchee (WDFW 1997). Four distinct spawning stream reaches remain in this subpopulation (K. MacDonald, USFS, *in litt.* 1996).

The Icicle Creek subpopulation consists of resident bull trout isolated above the Leavenworth NFH dam. A total of 11 bull trout were observed in surveys in 1994 and 1995 (Ringel 1997). Migratory bull trout are observed occasionally below the dam and are believed to originate from the subpopulation upstream (K. MacDonald, USFS, *in litt.* 1996). The Ingalls Creek

subpopulation is composed primarily of resident fish. Eight bull trout were observed during snorkel surveys of the creek in 1995 (Ringel 1997). USFWS considers the Icicle and Ingalls creeks subpopulations to be at risk of stochastic extirpation due to their inability to be re-founded, their single life-history form and spawning area, and their low numbers.

Methow River basin. USFWS identified four bull trout subpopulations in the Methow River basin: 1) Methow River, 2) Lost River, 3) Goat Creek, and 4) upper Early Winters (K. Williams, WDFW, *in litt.* 1996).

The Methow River subpopulation is composed primarily of migratory (fluvial) fish. In the mainstem Methow River, up to 79 percent of the average flow is removed from a 40-mile reach, occasionally stranding and killing bull trout. Due primarily to temperature constraints in partially dewatered tributaries to the Methow River, 60 percent of the total spawning and rearing area for bull trout has been lost (Mullan et al. 1992). There appears to be sufficient connectivity to allow bull trout access to spawn in various reaches of seven tributaries (Gold, Wolf, and lower Early Winters creeks, and Twisp, West Fork Methow, lower Lost, and Chewack rivers) (WDFW 1997). The number of redds observed at 21 transects in the 7 streams was 0 to 27, with an overall mean of 9.4 per stream (K. Williams, WDFW, *in litt.* 1996).

The Lost River subpopulation is isolated in the upper portion of the watershed, which is considered to be a “stronghold” for bull trout. The subpopulation is composed primarily of resident bull trout, which in 1993 was estimated at over 1,000 resident and migratory fish (K. Williams, WDFW, *in litt.* 1996).

The Goat Creek subpopulation consists of low numbers of resident bull trout that are believed to be genetically distinct (WDFW 1997). They are isolated upstream by a culvert 6.8 miles from the confluence and, in dry years from July through October, by low flows across an alluvial fan at the confluence with the Methow River.

The upper Early Winters Creek subpopulation, also resident, is isolated above a waterfall 7.9 miles from the confluence with the Methow River. USFWS considers the Goat Creek and upper Early Winters Creek subpopulations at risk of stochastic extirpation due to their inability to be re-founded, their single life-history form and spawning area, and their low numbers.

2.2.3) Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of listed fish in the target area, and provide estimated annual levels of take.

- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.
 - Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.
 - Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).
- Broodstock collection between early September and early December could take steelhead adults and, less likely, bull trout adults, by handling and delaying migration. (Spring chinook do not migrate when the trap is operating.)
 - Trapping for predation studies between March and June at the mouth of Nason Creek could take spring chinook, steelhead, and bull trout juveniles, either by exposing them to greater risk of predation while in the live box, or by handling.
 - Weirs in small tributaries such as Chumstick, Brender, and Beaver creeks, could take juvenile or adult steelhead while monitoring juvenile coho emigration or adult returns.
 - Tow-net sampling in Lake Wenatchee could take bull trout juveniles through injury or handling stress. A low potential exists for lethal take.
 - Electro-fishing for carrying capacity and condition surveys could take bull trout, chinook and steelhead. Adverse effects could be caused by extra handling, or fish could be killed if improper shocking procedures are used.
 - Trapping of returning coho adults at Priest Rapids and Tumwater dams for a radio telemetry study could encounter steelhead (and bull trout at Tumwater), causing minimal handling and migration delay.
 - Snorkeling surveys could encounter all ages and species of listed fish. A very low potential exists for harassment.
 - Juvenile trapping at the outlet to Lake Wenatchee and broodstock collection at Wells Dam would be done within the limits of existing permits, so those activities would not lead to additional take of listed species beyond what already occurs.
 - Broodstock at Winthrop NFH are taken from coho that swim into the hatchery, so listed fish would not be affected.

Numbers of listed fish that might be taken during each activity are shown in the “take tables” in Appendix A. Details of the activities and potential take are described below. The risk of adverse ecological interactions between listed fish and coho smolts in the natural environment is discussed in section 3.5.

Wenatchee Basin

- **Dryden Dam:** The Dryden Dam trap is operated five days per week from July 1 to November 14 each year for steelhead broodstock collection under WDFW's Section 10 permit (#1094). The coho broodstock collection program has been operating within the parameters of that permit. In order to collect coho broodstock throughout the entire run, however, YN requested and was granted an extension of the trapping period from November 14 to December 7.

Extending the trapping period an additional three weeks (November 14 – December 7) will result in additional handling of an unknown number of Upper Columbia River steelhead. WDFW's 2001 steelhead trapping at Dryden Dam terminated on November 9th and never extends beyond November 14th. Therefore, no data exist to project steelhead captures during the November 14 - December 7 period. During the six trapping days from November 1 – 9, 2001, 10 steelhead were observed, for an average of 1.66 steelhead per day of trapping. If this capture rate were indicative of the expected rate during the requested extension period (approximately 15 trapping days), an estimated 25 additional adult steelhead may be trapped, handled and released as a result of the trapping extension. If the steelhead passage timing observed during 2001 is indicative of a "normal year," then the lengthened trapping period would account for a relatively small proportion of the total steelhead migration. In fact, the low-flow conditions of 2001 delayed steelhead migration, so that in a normal year, even fewer would be encountered during coho trapping. In any event, we do not expect additional steelhead mortality, as no mortality has been observed during the existing trapping period.

The trap is checked daily to identify captured steelhead as natural or hatchery origin. A Denil ladder is operated up to three hours per day to ensure upstream passage of fish released from the trap (NMFS 1998(b)).

Bull trout are unlikely to be captured in the Dryden trap. Although USFWS estimated an annual lethal take of one adult bull trout and take by trapping of five adults for all broodstock collection activities (USDI FWS 2001), based on our experience, we expect no lethal take and only two captured and released, with minimal delay in their migration.

- **Tumwater Dam:** Coho broodstock collection at Tumwater Dam also has operated according to the parameters of the existing WDFW Section 10 permit (#1094) for steelhead broodstock collection. The trap currently operates three days a week, 8 hours a day (although we understand that it is permitted to operate 16 hours a day), and trapping ends in mid-November. YN requested and was granted an extension of the trapping period until December 7. The extension will allow broodstock collection, if necessary, over the entire run. In addition, it will allow more complete enumeration of "natural" adult coho returns to the upper Wenatchee and more opportunity to radio tag adult coho to help identify spawning locations. Recent modifications allow Tumwater, like Dryden Dam, to be operated passively.

Extending the trapping period an additional three weeks (same time period as Dryden) may result in capture, handling and release of additional upper Columbia River steelhead from that which would have occurred under the existing trapping protocol. During the proposed trapping extension period (November 15 – December 7), 21, 0, 1, and 107 steelhead were observed passing Tumwater Dam in 1998 through 2001, respectively (K.

Peterson, NOAA Fisheries, personal communication, September 2002). We do not anticipate any additional mortality as a direct result of the extended trapping operation, as no mortality has been observed during the existing trapping period.

Bull trout are fall spawners, typically in September and October for most populations (Pratt 1992). Video counts at Tumwater show that bull trout rarely migrate past the dam during September and October. Operation of the trap during the period of bull trout spawning is therefore not likely to impact their seasonal movement, since most likely will be spawning in headwater tributaries during this period. Any bull trout caught in the trap would be removed and released immediately. USFWS estimated an annual lethal take of one adult bull trout and take by trapping of five adults for all broodstock collection activities (USDI FWS2001); however, in our experience, bull trout have not been trapped, and there has been no lethal take.

- Leavenworth NFH: Coho would be trapped at Dam 5 or at the fish ladder, using both the right and left bank ladder traps. There is a very low potential to trap bull trout and steelhead while collecting coho broodstock. Steelhead in Icicle Creek are thought to be remnants of an old USFWS program. An average of 15-20 steelhead adults return per spawning season, most during March and April. The odds of catching one in the coho traps in the fall are extremely low (D. Carie, personal communication, 12/10/99). Bull trout spawn in the fall, but earlier than coho. The potential for catching one in a trap during the coho broodstock collection period is greater than for steelhead, but still low. Traps will be checked daily and any listed species released immediately.
- Nason Creek Smolt Trap: The rotary trap operated at RM 2 on Nason Creek probably will capture some spring chinook, bull trout, and steelhead juveniles. Take tables in Appendix A show numbers of chinook juveniles and eggs/fry expected to be taken for both the hatchery smolt predation and naturalized coho (fry plants) studies. During the 2001 study of coho smolt predation on spring chinook (see section 3.5.3), YN trapped and handled 133 spring chinook smolts and 126 spring chinook fry. Spring chinook runs past a WDFW smolt trap on the Chiwawa River as well as the Monitor trap showed that the spring chinook smolt migration peaked prior to the coho release and start of the predation study. As a result, only a limited number of spring chinook actually encountered our trap. All juvenile spring chinook captured were released and passed downstream within an hour. We observed no spring chinook mortality caused by the trap.

However, by beginning the trap operation in March rather than May for the naturalized coho predation study, we likely will encounter the peak spring chinook out-migration. For this reason, the take tables in Appendix A show higher numbers of spring chinook encountered than would be indicated by our past experience with this trap.

During a one-month period, the trap captured 8 juvenile bull trout and 303 juvenile steelhead, with no observed mortality. We estimate an annual incidental lethal take of one juvenile bull trout and the capture, handling, and release of 25 juvenile bull trout annually; and the capture, handling, and release of 500 juvenile steelhead, with a potential for an annual incidental lethal take of 10 steelhead juveniles (Appendix A).

- Tributary weir traps: Weirs might be set up to monitor juvenile emigration or adult returns at smaller tributaries, such as Chumstick, Brender, and Beaver creeks, where

natural spawning is expected in the future. Such traps have not yet been used for the project, so we cannot report actual experience with take. Take tables in Appendix A predict potential steelhead take, including a maximum potential unintentional lethal take of 5 juveniles. Listed spring chinook and bull trout are not expected to be encountered in these tributaries.

- Tow-net sampling: The tow nets proposed for this study (see section 11.1.1) are designed to capture sockeye fry. With the type of nets and the speed at which they would be towed (under 7 mph), bull trout older than one year are unlikely to be captured due to their size and ability to maneuver away from the nets (USDI FWS 2001). In addition, bull trout rear in tributary streams and typically do not migrate to the lake until they are larger than the size fish the nets are designed for (K. Murdoch, pers. comm. 2002).

While the net is designed to create a safe reservoir for entrained fish, and all listed fish are removed after a 10-minute deployment, USFWS estimated an incidental lethal take of 5 juvenile bull trout and a trapping take of 15 juvenile bull trout (USDI FWS 2001).

During 2002 YN staff captured only sockeye fry and sockeye smolts. All smolts were released uninjured (no descaling or visible injury). We encountered no bull trout or spring chinook in 2001 or 2002. If spring chinook are present in the lake, they are not pelagic and will not be found in the center as sockeye are (where we are tow netting). Spring chinook would be found only near the lake edges. Therefore, we estimate no take of spring chinook or bull trout from tow netting.

- Electro-fishing: Electro-fishing has the potential to injure fish. Although most, if not all stunned adult and juvenile fish appear to recover sufficiently to swim away, long-term effects or effects that do not result in immediate mortality are not well understood (USDI FWS 2001). During research in the Columbia River basin, an electro-shocking injury level for incidentally shocked juvenile salmon has been estimated at 10 percent (M. Schuck, fishery biologist, Washington Department of Fisheries, pers. comm. *in* Scholz 1992). Barton and Dwyer (1997) found that, for juvenile bull trout, electro-shock resulted in increased plasma glucose and plasma cortisol levels indicative of acute stress (*in* USDI FWS 2001).

We estimate that 150 spring chinook juveniles and 150 steelhead juveniles could be captured and released during electro-fishing, with the potential for an unintended lethal take of 15 of each species annually. In its Biological Opinion on the coho feasibility studies, the USFWS assumed that all take of bull trout would be lethal take, to avoid underestimating the level of take, and estimated an annual lethal take of 3 adult and 10 juvenile bull trout; however, to date, we have not encountered bull trout in our electro-fishing activities. To reduce the potential for fish mortality, USFWS required that YN and BPA use the NMFS electro-fishing guidelines (NMFS 1998(a)) *and* guidelines found in Fredenberg (1992).

- Snorkeling surveys: Snorkeling surveys for coho juveniles and adults would be done near release sites. It is possible that a snorkeler could frighten a fish from its hiding place, causing it to be caught and eaten by a predator. However, the low number of surveys per year on any particular stream (up to three on Nason Creek), the short amount of time a snorkeler would spend in any reach, and the snorkeler's training to observe

only, make it unlikely that the surveys would cause injury to or significantly disrupt normal behavior of listed fish as described in the NMFS definition of “harass” (NMFS 1996).

Methow Basin

Broodstock collection and snorkeling surveys could encounter listed fish (bull trout and steelhead) in the Methow basin. The effect of snorkeling surveys would be similar to that described for the Wenatchee basin.

Peak adult steelhead migration occurs in September and October, and extends from August through November (L. Brown, WDFW, personal communication, 1999). Wild steelhead adults destined for the Methow basin overwinter in the Wells pool on the Columbia River and spawn in April and May. During the coho broodstock collection period, there is an overlap in adult steelhead and adult coho migration timing past the upper mainstem projects. The overlap is most prevalent in late October and extends into November.

- **Wells Dam:** Beginning in fall of 1999, coho adults returning to the Methow basin were trapped at Wells Dam on the Columbia River. The dam is equipped with traps to collect adult fish. WDFW currently operates the traps to collect steelhead adults, which return at similar times to coho. The current steelhead protocol is to operate the trap for 3 days a week, up to 16 hours a day. If runs are large enough, we do not trap at Wells but rather allow the coho adults to swim to the WNFH. If the runs are predicted to be less than 150 fish for the Methow, we would trap at Wells as often as WDFW’s permit (#1094) allows. We will be trapping at Wells in fall 2002. There has been no steelhead mortality associated with this trap.

Adult bull trout distribution in the mainstem Columbia River near Wells Dam is unknown. In recent years, no bull trout have been observed via video monitoring at Wells Dam between September 15 and November 7 (R. Klinge, Douglas County Public Utility District, personal communication), probably due to temperature constraints in the mainstem Columbia River during that period. We do not anticipate handling any bull trout at Wells Dam during coho broodstock collection.

Any listed fish caught in the trap will be released immediately.

- **Winthrop NFH:** Coho would swim directly into the hatchery, so listed species would not be affected. Because this is the only release site for coho smolts in the Methow basin, the coho are expected to be well-imprinted on the hatchery, resulting in good collection rates.

Priest Rapids Dam

The project is proposing to radio tag up to 400 adults over the next 4 or 5 years at Priest Rapids Dam in order to study homing and straying of coho adults. WDFW currently operates a trap at the dam for stock assessment. The coho project would trap during part of WDFW’s trapping period, but also has requested an extension of the trapping date to November 21st from the current ending date of October 14th so that a statistically significant number of adult coho can be trapped and radio tagged. The number of days per week would remain at two.

When WDFW is not trapping for their purposes, steelhead will be incidentally collected in the adult trap at the dam. Tribal or WDFW personnel will be present to sort and handle the fish while the trap is collecting coho adults. There is no off-ladder holding area at the trap. Therefore, when listed steelhead are incidentally trapped, they will be returned immediately back to the fish ladder upstream of the trap. We expect the impacts to steelhead to be minor, with minimal migration delay and no increased mortality. The 50 adult steelhead shown in the take table in Appendix A indicates the number that might be captured during the trapping extension only.

- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

While YN does not anticipate exceeding any prescribed take levels during any M&E or broodstock collection activities, if they should happen to do so, they will cease the activity, immediately notify the proper regulatory agency, and proceed based on their decision. Options might include reducing trapping days or using other sites.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. Hood Canal Summer Chum Conservation Initiative) or other regionally accepted policies (e.g. the NPPC Annual [sic] Production Review Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

There is no ESU-wide hatchery plan for these basins. The *Biological Assessment and Management Plan, Mid-Columbia River Hatchery Program* (NMFS et al. 1998) identifies actions in mid-Columbia basins to address needs of several listed species. Although coho were included in general policy statements, specific actions were not identified for that species. The coho program is consistent with policies addressing restoration projects in NPPC document 99-15, although its phased approach to coho reintroduction is more conservative than the guidelines outlined in the *Artificial Production Review* (NPPC 1999).

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates. Since the 1990s, various entities in the Pacific Northwest have renewed the region's focus on reintroduction of coho to mid-Columbia tributaries.

The four Columbia River Treaty Tribes (Nez Perce, Umatilla, Warm Springs, and Yakama) identified coho reintroduction in the mid-Columbia as a priority in the *Wy-Kan-Ush-Mi-Wa-Kish-Wit* document, commonly referred to as the Tribal Restoration Plan (TRP) (CRITFC 1995).

It is a comprehensive plan put forward by the Tribes to restore the Columbia River fisheries. This project is the initial phase necessary to determine the feasibility of implementing that long-term vision in the mid-Columbia region.

In 1996, the Northwest Power Planning Council (NPPC) recommended the tribal mid-Columbia reintroduction project for funding by BPA, which has responsibilities under the Northwest Electric Power Planning and Conservation Act of 1980 to protect, mitigate, and enhance fish and wildlife that have been affected by the construction and operation of the Federal Columbia River Power System. It was identified as one of fifteen high-priority projects for the Columbia River basin, and was incorporated into the NPPC's Fish and Wildlife Program (program measures 7.1H, 7.4A, 7.4F, and 7.4O) (as documented in NPPC 1994). The project received a partial Step-Two review by the Council in August 2000 and will be subject to full Step-Two and Step-Three reviews once the feasibility phase is completed and the time is ripe to consider full implementation of the long-term vision.

The release of coho from lower Columbia hatcheries into mid-Columbia tributaries is also recognized in the Columbia River Fish Management Plan, a court-mandated plan under the jurisdiction of *U.S. v. Oregon*, involving Federal, state and tribal fish managers in the Columbia basin (CTWSR et al. 1988). While this project is not mandated under that court order, fish produced under that plan supply the project.

The *Biological Assessment and Management Plan, Mid-Columbia River Hatchery Program* (NMFS et al. 1998) also recognizes the potential for coho reintroduction in mid-Columbia basins, although coho-specific plans and analyses were outside the scope of that document.

Plans for the initial feasibility research phase of this project were outlined, revised, and analyzed in several documents, primarily *Mid-Columbia Coho Salmon Study Plan* 11/25/98 (YIN 1998); *Mid-Columbia Coho Reintroduction Feasibility Project Final Environmental Assessment* (USDOE BPA 1999(b)) and *Supplement Analyses* (USDOE/BPA 2001(b) and USDOE/BPA 2001(d)); *Biological Opinion: 1999 Coho Salmon Releases in the Wenatchee River Basin by the Yakama Indian Nation and the Bonneville Power Administration* (NMFS 1999(b)); and *Biological Opinion: Mid-Columbia Coho Reintroduction Feasibility Project, FWS Reference: 01-F-E0231* (USDI FWS 2001). In addition, a Biological Assessment was prepared by BPA on the proposal to dredge the area behind Dam 5 at Leavenworth Hatchery (USDOE/BPA 2001(c); its findings received concurrence from NMFS in a letter dated September 28, 2001 and from USFWS in a letter dated November 16, 2001.

The U.S. District Court ruled on March 22, 1974 that the Yakama Nation and Washington Department of Fish and Wildlife co-manage fish resources in Washington state. This decision is commonly referred to as the Boldt Decision.

A Memorandum of Understanding, dated 12/27/93, stipulates that the Wenatchee National Forest (WNF) and the YN will cooperatively manage fish resources on the Wenatchee National Forest.

This HGMP is consistent with all these plans, analyses, agreements, memoranda, and court orders.

3.3) Relationship to harvest objectives

3.3.1) Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.

The long-term vision of the Tribes is to re-establish coho in sufficient numbers to provide significant harvest opportunities for Tribal and non-Tribal fishers in mid-Columbia tributary basins. For the period covered by this plan, however, the numbers of returning coho are not expected to be high enough to justify establishing a fishery in the mid-Columbia basins. Harvest levels of all existing Columbia River and ocean fisheries (Tribal and non-Tribal) could be adjusted once escapement goals for upriver coho are agreed to by all parties. Without a coho fishery in the target basins, listed species in those basins would not be at risk.

The marking protocol for program fish has changed from that outlined in the original HGMP (see Tables 19-21, section 11.1.1). The most significant change is a commitment to internally identify or mark with a coded wire tag 100% of the hatchery fish released in both the Methow and Wenatchee basins by 2002 (a year sooner than originally indicated in the HGMP); however, they will not be adipose-clipped, in order to limit their harvest in selective fisheries that target adipose-clipped hatchery coho. This change, combined with current monitoring practices in the relevant fisheries, means that the effect of harvest on survival of program coho will be accurately and effectively assessed.

3.3.1.1) Description of existing fisheries

During their life cycle, this project's research coho might be in waters that are subject to the following fisheries: ocean commercial troll fisheries, ocean recreational fisheries, Buoy 10 recreational fisheries, lower Columbia River commercial fisheries, lower Columbia River recreational fisheries, Zone 6 (Bonneville to McNary) Treaty Indian commercial fisheries, and above Bonneville Dam recreational fisheries.

Ocean fishing seasons and regulations are adopted annually by the Pacific Fisheries Management Council (PFMC). Ocean fisheries for coho are managed on a quota or total allowable catch basis pursuant to objectives in the PFMC's fishery management plan. Because of weak stock constraints, non-Indian commercial troll fisheries targeting coho (especially in areas where Columbia River coho are present) have been very limited since 1994. However, recreational coho fisheries have continued. In 1998, the PFMC adopted the first selective fisheries for coho in recreational fisheries off the mouth of the Columbia River. The states of Washington and Oregon also adopted selective fishery regulations for the popular Buoy 10 fishery in the Columbia River estuary. Washington and Oregon began mass marking (removing adipose fins from) hatchery coho in 1995. Selective fishery regulations required all retained coho to have a healed adipose fin clip. These fisheries generally begin in early August and run through late August to late September.

Mainstem Columbia River sport fisheries typically begin August 1, but generally target chinook and steelhead with minimal harvest of coho. Mainstem commercial fisheries in the lower Columbia River generally occur from mid-September through October. Treaty commercial fisheries in Zone 6 generally occur from late August through early October. Some coho (mostly late stock) are harvested in the latter part of this fishery.

Fisheries may also occur in tributary areas. The Yakama Nation regularly conducts fisheries in the Yakima and Klickitat rivers in the late fall (October to December) targeting fall chinook and coho. The state of Washington also reinitiated a late fall fishery in the Yakima River in 1998 which is expected to continue. The Yakama Nation and/or state of Washington may choose to adopt similar late fall fishing seasons in upper Columbia areas once coho populations are reestablished to levels which would support a fishery; however, adult returns are not expected in sufficient numbers in the next 5-6 years to support a coho fishery in the target basins.

3.3.1.2) Expected harvest rates

Upper Columbia River coho adult returns are a sub-component of the Columbia upriver early stock coho return. Average harvest rates in non-Indian ocean and Columbia River fisheries for marked and unmarked Columbia upriver coho can be estimated using data provided in 1999 by the joint staffs of the Oregon and Washington departments of fish and wildlife. Data include release locations, marking levels, and 1998 selective fishery surveys. Total harvest rates for upriver early coho average about 20% in ocean fisheries and 15% in mainstem Columbia River fisheries for a total harvest rate of about 35% on upriver early-stock coho. Harvest rates on marked (hatchery-released coho) are estimated to average about 30% in ocean fisheries and 20% in river fisheries for a total harvest rate on marked upriver early-stock coho of 50%. Harvest rates on unmarked coho are estimated to average about 12% in ocean fisheries and 11% in river fisheries, for a total harvest rate on unmarked upriver early-stock coho of 23%. Currently non-Indian fisheries are managed to assure that at least 50% of the total upriver coho return (combined early and late stocks) escapes above Bonneville Dam.

Harvest rates of 10% or more on upriver coho stocks in combined Treaty Indian Zone 6 and tributary area fisheries could also occur. Harvest rates for all ocean and Columbia River fisheries (Treaty Indian and non-Indian fisheries) would adjust annually to be consistent with escapement goals for upriver coho once these goals are established and agreed upon by all the parties.

In sum, the total harvest rate on non-adipose-fin-clipped coho is likely to be 20 – 25% due to the selective fisheries that are likely to remain in place for many years as a result of ESA constraints (Mid-Columbia Coho Reintroduction Feasibility Project, Responses to ISRP Comments on Partial Step-Two Review, August 2000).

3.4) Relationship to habitat protection and recovery strategies.

Mid-Columbia coho salmon populations were decimated in the early 1900s by impassable dams and unscreened irrigation diversions in the tributaries, along with an extremely high harvest rate in the lower Columbia River. The loss of natural stream flow degraded habitat quality and further reduced coho productivity. Over the years, irrigation, livestock grazing, mining, timber harvest and fire management also contributed to destruction of salmon habitat.

Mullan (1983) estimated historical mid-Columbia River adult coho populations as follows:

- Wenatchee—6,000 - 7,000
- Methow—23,000 - 31,000
- Entiat—9,000-13,000

- Okanogan—Presence documented but no numbers specified

Indigenous natural coho salmon no longer occupy the mid-Columbia river basins. Since Priest Rapids Dam was completed in 1960, the peak escapement of adult coho upstream of the dam was probably never greater than 10,000 coho and has not exceeded 1,300 since 1974 (WDFW/ODFW 1998). From 1988 to 1997, adult counts at Priest Rapids Dam averaged only 16 coho, probably a result of releases from Turtle Rock Hatchery, which annually released about 600,000 coho smolts, until the program was terminated in 1994 (WDFW/ODFW 1995).

For several reasons, self-sustaining coho populations were not established in mid-Columbia basins despite plantings of 46 million fry, fingerlings, and smolts from Leavenworth, Entiat, and Winthrop national fish hatcheries between 1942 and 1975:

- The construction and operation of mainstem Columbia River hydropower projects were detrimental to mid-Columbia River salmonid populations because of the number of dams and reservoirs through which they had to pass, leading to deaths from turbines, gas bubble trauma, and so forth.
- A substantial amount of critical physical fish habitat was lost or severely degraded (Tyus 1990; Petts 1980; Diamond and Pribble 1978).
- Existing coho programs were unsuccessful or lower priority than programs for other salmonid species. For example, the most recent coho hatchery program in the mid-Columbia region was at Turtle Rock Hatchery, funded by Chelan PUD. The coho program was terminated due to poor adult returns, thought to be caused in part by disease problems at the hatchery. Because fall chinook and steelhead were higher priority species, they were given priority use of the limited supply of high quality hatchery water. These species currently constitute the program at Turtle Rock. The last coho releases were in 1994.

Since that time, conditions and practices have changed to a certain degree. Some of the local habitat causes of coho depletion have been corrected, although there is still work to be done. For example, many irrigation diversions have been screened, tributary dams have been removed, mining has ended, and grazing practices have been improved. A few specific examples of projects designed to improve conditions for fish in the target basins include:

Wenatchee Basin:

- improvements in fish passage at Tumwater and Dryden dams
- fish screens at Dryden Dam
- replacement of Chumstick Creek culverts

Methow Basin:

- improvements to the Methow Valley Irrigation District system
- restoration of salmonid habitat in Early Winters and Goat creeks

Similar improvements have been made on the mainstem Columbia.

Another significant change in regional conditions is that the ESA listings of several salmonid species that migrate through the lower Columbia River have curtailed coho fisheries that once

over-harvested the mid-Columbia stocks of coho. These fisheries restrictions are likely to be in effect for a number of years.

Recent improvements in artificial production methodology may also improve efforts aimed at supporting natural production. Supplementation techniques, featuring refined genetic objectives, the production of “natural-like” hatchery smolts, and acclimation/release in wild habitat, are being developed.

Because of these changed conditions, feasibility studies into restoring coho to these basins are consistent with guidance in NPPC’s document 99-15 (NPPC 1999).

3.5) Ecological interactions

One of the primary goals of the coho feasibility studies is to assess interactions with other species and to minimize any adverse effects identified. The NEPA document prepared on the feasibility studies (USDOE/BPA 1999(b)) assessed potential interactions based on information available at the time. Subsequent residualism and predation studies showed little or no adverse effect of hatchery coho smolt releases. Additional predation and F2 interactions studies are ongoing or planned. Results of existing assessments are summarized in the following sections.

Because many negative impacts of ecological interactions among species are density-dependent, the estimated carrying capacities of selected Mid-Columbia rivers and streams (if the habitat were to be “fully seeded”) are shown in Table 10 as an aid to assessing the near-term risks to other species. These carrying capacity estimates should be considered minimum for the basins, because they include only the main tributaries listed; the majority of fisheries experts agree that, in natural conditions, coho use small creeks in their early life history. Based on the following analysis, and on other discussions with the Mid-Columbia Technical Work Group, we expect that the numbers of hatchery coho released in the Wenatchee or Methow basins are unlikely to result in returning adults sufficient to produce natural origin juveniles in numbers that would exceed the carrying capacity of the tributaries/reaches near the release locations.

The method used to calculate the carrying capacities is presented below. Other methods used by Technical Work Group members have resulted in similar ranges of numbers.

3.5.1) Method for Estimating Carrying Capacities:

We compiled and summarized existing physical habitat inventory for the largest tributaries of the Wenatchee (Little Wenatchee, Nason Creek, White and Chiwawa rivers) and Methow (upper Methow, Chewuch and Twisp rivers) basins. We did not develop estimates for smaller tributaries, so these estimates likely underestimate the potential available habitat and therefore the coho smolt carrying capacity within these watersheds. The U.S. Forest Service collected the data using the Hankin and Reeves (1988) methodology. For each tributary of interest, we tabulated the total stream area by habitat type (pool, glide, riffle, side channel, etc.). We used summer stocking densities presented by Reeves et al. (1989) to estimate the total potential summer standing crop of coho parr within each tributary. In order to estimate adult coho escapement required to fully seed the habitat at these levels, we needed estimates of adult coho sex ratio (D. Dysart, personal communication), life-stage-specific survival rates, and coho fecundity (Yakama Nation, unpublished data). Life-stage-specific survival rates (L. Lestelle personal communication) were partitioned into the egg-to-emergent fry, emergent fry colonization, and summer and winter parr survival. These survival rates are considered to be near optimal and therefore likely overestimate survival within these watersheds.

Female escapement (FE) and adult coho escapement (AE) required to achieve coho smolt carrying capacities (CC) were estimated using the following formula:

$$FE = \frac{CC}{F \times EFS \times FCS \times SPS \times WPS}$$

$$AE = \frac{FE}{SR}$$

Where F = average fecundity (2750 eggs/female)
 EFS = egg-to-emergent fry survival (60%),
 FCS = emergent fry colonization survival (80%),
 SPS = summer parr survival (75%),
 WPS = winter parr survival to spring smolt (50%), and
 SR = female sex ratio (percent females: 50%)

Assumptions

- Methodology presented by Reeves et al. (1989) accurately estimates potential natural coho summer parr stocking densities within these watersheds.
- Fecundity, sex ratios, and survival rates are realistic.
- Coho survival at life stages earlier than spring smolt will not limit spring smolt production.

Table 10. Estimated Coho Carrying Capacity of Selected Mid-Columbia Basins

Wenatchee	Summer Natural Stocking Capacity	Spring Smolt Natural Stocking Capacity	Female Escapement	Adult Escapement
Nason Creek	845,676	422,838	854	1,708
White River	681,656	340,828	689	1,377
Chiwawa River	887,348	443,674	896	1,793
Little Wenatchee	157,592	78,796	159	318
Total	2,572,272	1,286,136	2,598	5,196
Methow	Summer Natural Stocking Capacity	Spring Smolt Natural Stocking Capacity	Female Escapement	Adult Escapement
Methow River	2,638,180	1,319,090	2,665	5,330
Chewuch River	1,119,008	559,504	1,130	2,261
Twisp River	709,108	354,554	716	1,433
Total	4,466,296	2,233,148	4,511	9,024

Assumptions

1. Reeves et al. (1989) accurately estimates natural coho summer parr stocking densities
2. Fecundity = 2750 eggs/female
3. Egg to fry survival = 60%
4. Fry dispersal survival = 80%
5. Fry to summer parr survival = 75%
6. Over-winter survival = 50%
7. Adult sex ratio (female) = 50%
8. Estimates are minimum because they include only the mainstem tributaries listed

Sources

1. Physical habitat inventory for each tributary Hankin and Reeves (1988) collected by USFS
2. Sex ratio (Doug Dysart, personal communication)
3. Survival rates (Larry Lestelle, personal communication)
4. Fecundity estimates (Yakama Nation, unpublished information)
5. Coho summer stocking density estimates (Reeves et al. 1989)

3.5.2) Species that could negatively impact the success of the program:

Historically, bull trout and northern pikeminnow (*Ptychocheilus oregonensis*) were probably the most significant fish predators within the Methow, Wenatchee, and Entiat basins. Today bull trout abundance in most parts of these three basins is low and would not be expected to limit project success. However, Lake Wenatchee is a stronghold for the local bull trout population. Predation rates by bull trout on coho smolts released into the Little Wenatchee or White River could be significant.

Although little information exists about the abundance of northern pikeminnow for the mainstem Methow, Wenatchee or Entiat basins, the abundance of this species is assumed to be relatively low and probably accounts for a small portion of juvenile mortality in freshwater. Several non-endemic centrarchid and ictalurid species are present in the mainstem Columbia River, but the potential impact of these species on project success is unknown.

River otters, mergansers, and bald eagles, among other non-fish predators, are known to eat coho smolts acclimating in uncovered, natural-style ponds, but exact numbers are unknown. Project staff are examining non-toxic, non-lethal methods to control predation by such species.

Project activities are not expected to appreciably change the functional or numeric response or the long-term abundance of predators within the Methow, Wenatchee, or Entiat basins, or in the mainstem Columbia River. This is due to the relatively large number of all species of hatchery fish that currently rear and/or migrate within these areas.

3.5.3) Species that could be negatively impacted by this program:

Ecological interaction risks include predation by coho on other species of concern, competition between coho and other species, residualism, straying, and transfer of disease.

In this section, analysis of ecological interactions focuses on those that could occur within the Wenatchee and Methow river basins, as these basins are where releases are most likely during the time period of this plan. The nature of the impacts in the Entiat basin, should coho be released there, would for the most part be similar to those expected in the Methow and Wenatchee. The species within each basin that potentially could be adversely affected by the project would be the same for F₂ and hatchery fish and are listed in section 2.2.1.

In addition to listed species in mid-Columbia basins, coho smolts encounter other listed stocks and species while migrating in the Columbia River and its estuary. The potential for adverse interactions between coho and other listed species in the mainstem is discussed at the end of this section.

Predation

Predation effects can be direct or indirect and are related to the release of hatchery smolts into the natural environment. For this analysis, direct predation refers to coho consumption of another species. Indirect predation refers to either the increased or reduced levels of predation on other species as a result of the release of large numbers of coho smolts. These indirect effects are being studied in the Yakima basin with inconclusive results so far (YN YKFP 2000). There is no evidence to suggest that an indirect predation risk exists in mid-Columbia basins.

Although the impact of predation on an individual prey animal is unambiguous, the impact on a population of prey is not. Depending on the abundance and productivity of the prey population, the impact of predation on the persistence and productivity of the prey population may range from negligible to serious. The relative impacts of predation on a prey population are determined by partitioning the sources of freshwater mortality and comparing the relative magnitude of each source. Size of hatchery fish appears to be relevant to whether or not the supplemented species will prey significantly on other fish species (Hillman and Mullan 1989).

Coho salmon have been shown to prey on several species of salmonids including sockeye salmon (*O. nerka*) fry (Ricker 1941; Foerster and Ricker 1953; Ruggerone and Rogers 1992); pink (*O. gorbuscha*) and chum (*O. keta*) salmon fry (Hunter 1959); spring chinook fry (Dunnigan and Hubble 1998); and fall chinook salmon (Thompson 1966; Dunnigan and Hubble 1998).

In the mid-Columbia basins, the species most at risk for direct predation is spring chinook; sockeye salmon could be at risk in certain parts of the Wenatchee basin, especially downstream of any acclimation site above Lake Wenatchee. Spring chinook spawn in higher reaches of the watershed and emerge from the gravel later than summer/fall chinook, due to the colder water; and young-of-the-year spring chinook are smaller than coho when coho begin migrating. Sockeye emerge at about the same time as coho and rear in habitat proposed for coho acclimation in the Wenatchee basin. Summer/fall chinook spawn lower in the watershed, and emerge sooner than coho. They are smaller than coho, and there has been concern that summer/fall chinook would be prey for coho. However, studies in the Yakima basin, as discussed below, have shown that coho predation on fall chinook is very low. Most resident trout and steelhead are not considered to be at risk because these species generally emerge from the gravel after coho have migrated downstream, or, as in the case of bull trout, spawn in upper reaches of tributaries. See section 2.2.1.

The potential for impact to each listed or sensitive species is discussed in more detail below. We include summaries of research that studied coho predation on non-listed species because their findings are relevant to the feasibility questions in these basins.

Coho Salmon Predation on Fall Chinook

Studies of coho predation on fall chinook were conducted in the Yakima basin at the Chandler Juvenile Monitoring Facility (CJMF) in 1997 and 1998. They indicate that coho predation on fall chinook was 0.1% of all fall chinook smolts produced above Prosser, or the equivalent of 3.7 fall chinook adults. However, researchers believe that the artificial conditions associated with

CJMF create abnormal opportunities for predation (the fish are at unnaturally high densities in unnatural habitat with no cover against predators, and fish are potentially held several hours in the livebox before being examined) (Dunnigan and Hubble 1998).

Coho predation studies were also conducted in 1997 and 1998 in the open Yakima River (Dunnigan and Hubble 1998). There the observed rate of coho predation on fall chinook was zero: none of the coho sampled in either year contained remains of fall chinook. Calculations were then made, using two different methods, to estimate what total coho predation on fall chinook in the Yakima River might have been. Because the 1997 sample size was small, calculations made from it were not precise and the estimates ranged to absurd numbers. However, despite the small sample size, it seems likely that sampling reflected actual consumption rates in the river during the 1997 coho outmigration (Dunnigan and Hubble 1998). Conditions were not conducive for sight-feeding predators such as coho to be highly successful. Flows were extremely high and the water was turbid. Coho salmon migrated rapidly during this period (averaging 160 kilometers [100 miles] in 3 days) so the potential time for predation was limited. Predation rates on fall chinook by other sight-feeding predators such as smallmouth bass and northern pikeminnow were also relatively low during this period in 1997. It also seems highly unlikely that impacts in the river during 1997 would have been high given that coho predation at CJMF in 1997 was low and CJMF is perhaps the worst-case scenario for fall chinook predation (see above) (Dunnigan and Hubble 1998).

Sample sizes in 1998 allowed for more precise estimates of the total number of fall chinook consumed in the open river. Statistical analysis shows that, given an observed predation rate of 0% and a sample size of 462 coho, there was a 5% chance of observing a predation rate equivalent to the consumption of no more than 349 smolts (or approximately 3.5 adult fall chinook) (Dunnigan and Hubble 1998).

Coho Salmon Predation on Spring Chinook

Yakima River Basin

In 1997, YN snorkeling surveys in the Methow basin generally found emergent spring chinook fry in association with shallow (less than 12 inches), low-velocity backwater and spring brook channels, or close to large woody debris along shallow stream margins (Dunnigan and Hubble 1998). Wild coho juveniles progress through a series of preferred habitat types beginning with back eddies, then moving to log jams, undercut banks, open bank areas, and finally to fast water habitat (Lister and Genoe 1970). Dunnigan and Hubble's observations generally agree with Lister and Genoe's (1970), in that coho prefer deeper and faster water conditions than do spring chinook fry. Minimal spatial overlap tends to indicate limited opportunity for direct predation or competition. However, more definitive studies were required.

In 1998 and 1999, the YN studied coho predation on spring chinook, analyzing the stomach contents of coho sampled at a rotary trap in the Easton reach of the upper Yakima River. In 1998, five coho among the 981 sampled had consumed fish. Two of the prey items were identified as *Oncorhynchus* spp, consumed by a single coho. In 1999, only two of the 1,757 coho smolts sampled had consumed fish, neither of which was *Oncorhynchus* spp. Based on fry consumption estimates using the He and Wurtsbaugh (1993) gut evacuation model, researchers estimate that the total number of adult spring chinook equivalents consumed by coho was no higher than 7 (or 0.38% of the potential number of adult chinook returning to the study reach), assuming a 0.14% egg-to-adult survival rate (Fast et al. 1986) (Dunnigan 1999).

Although data collected in the Yakima basin seem to indicate that direct predation by coho is not a significant risk to spring or fall chinook, because the studies were done in a different basin and results were limited, additional predation studies were done in the Wenatchee basin.

Wenatchee River Basin

In 2001, the YN studied coho predation on spring chinook, analyzing the stomach contents of coho sampled at a rotary trap located at river mile 0.8 on Nason Creek. As reported in Murdoch and LaRue (2002), a total of 4,309 coho smolts were trapped during the study. Of these, a random sample from throughout the run of 1,094 fish were retained for stomach content analysis. Two coho, collected on the same date, had consumed spring chinook fry. This indicates a 0.18% incidence of predation. Using the generic model of gut evacuation rates presented by He and Wurtsbaugh (1993), and the mean residence time of 15.8 days, researchers estimated that the total number of spring chinook fry consumed during the outmigration was 2,436. This number likely is an overestimate because the mean residence time was calculated from the time the barrier nets in the acclimation pond were removed to the time each fish was captured in the smolt trap. However, fish remained in the pond up to three weeks after the net was removed. The actual time each fish spent in Nason Creek after leaving the pond until capture in the trap is unknown, but in most cases it probably was less than the mean residence time used in the calculations.

One hundred spring chinook redds were counted in Nason Creek in 2000, the highest density of spring chinook redds observed within the previous six years. Similar high numbers were observed throughout the region and are thought to be due to exceptionally favorable ocean conditions the previous year. Assuming an average fecundity of 4,200 and egg-to-fry survival rate of 60.0% (Fast et.al. 1986), the estimated number of spring chinook fry consumed by coho during the 2001 smolt migration was less than 1% (0.97%) of the spring chinook fry population in Nason Creek. This study may represent a worst-case scenario for coho smolt predation on spring chinook fry in Nason Creek due to the known over-estimate of residence time and the unusually high density of spring chinook, which is not expected to recur every year (Murdoch and LaRue 2002).

Other factors will further limit the risk of coho predation on spring chinook. In the Wenatchee basin,

- 1) in the near term, most returning coho adults will be captured for broodstock; and
- 2) planned natural coho spawning either will be limited to less sensitive areas for spring chinook, like Icicle Creek, or will be carefully monitored to determine the risk of negative interactions with chinook (see section 11.1.1).

In the Methow,

- 1) a large proportion of adult spring chinook are being collected for an adult-based supplementation program; and
- 2) most coho adults would be collected for broodstock.

Consequently, the opportunities for predation by naturally spawning progeny of these released fish would be minimal.

Coho Salmon Predation on Summer Chinook

The Yakama Nation, in cooperation with WDFW, evaluated coho predation on summer chinook in the Wenatchee basin during the 2000 smolt out-migration. The study was similar to studies conducted in the Yakima basin on spring and fall chinook. Hatchery coho smolts released from acclimation sites on Icicle Creek and Nason Creek in the spring of 2000 were recaptured in a WDFW-operated 8-foot rotary smolt trap. The trap was located on the Wenatchee River at river mile (RM) 7.1, near the town of Monitor. The study results described below are taken from the annual report by Murdoch and Dunnigan (2001).

During spring 2000, 12,243 coho smolts and 69,239 summer chinook fry were captured in the Monitor smolt trap. Of the 12,243 coho caught, 837 were retained for stomach content analysis. Protocol for the study required that the trap's live box be emptied of fish hourly. Unfortunately, this protocol was violated during the latter part of the study (after May 27th) and the live box was emptied once every three hours. During the study, coho predation of fish generally was uncommon. Between the release date and May 27th, four coho in the sample (0.6%) had consumed summer chinook. This compares to 17 coho that had consumed fish (9.8%) after the protocol had been violated (Table 11). When all samples are grouped, the incidence of predation was 2.5%.

Table 11. Incidence of Predation on Summer Chinook

Time Period	Number of coho sampled	Number of samples containing fish	Incidence of predation
Release to May 27	663	4	0.0060
May 28 to June 18	174	17	0.0977
Release to June 18	837	21	0.0250

We believe that this study represents the worst case scenario for the 2000 out-migration. The study reach contained the highest density of summer chinook redds in the Wenatchee River basin. All hatchery coho released from the Icicle Creek and Butcher Creek acclimation sites passed through this stretch of river. Additionally, data collected from the trap indicated that approximately 10.2 million summer chinook fry migrated past the trap during 2000 (T. Miller, WDFW pers. comm.), so fry were abundant and available for predation during the study.

Researchers measured a random sample of summer chinook fry captured in the trap and compared their lengths to those of summer chinook consumed by coho. Summer chinook fry consumed by coho were significantly smaller than summer chinook fry trapped in the live box. Results also indicated that the chinook fry consumed by coho were significantly smaller than the population of coho migrating past the Monitor smolt trap, implying that only the smallest of the fry, rather than the entire population, are vulnerable to predation by hatchery coho smolts.

Coho Salmon Predation on Sockeye Salmon

The risks of coho predation on sockeye salmon could be similar to spring chinook. Sockeye spawn upstream of most of the proposed release areas in the Wenatchee basin, but a significant number rear in Lake Wenatchee and would be present at times when coho smolts, if released above the lake as proposed, would be migrating through Lake Wenatchee (see Figure 2). Although not listed under ESA, sockeye in this area are considered a vulnerable species because

they are one of only two populations remaining in the Columbia River system (the other is in Lake Osoyoos [Okanogan River]) (Ken MacDonald, USFS, personal communication, 1999). Sockeye are considered to be introduced in the Entiat basin (USDA FS 1996), most likely wanderers from the Okanogan (NMFS et al. 1998).

Before significant numbers of coho are released upstream of Lake Wenatchee, YN is investigating the risks. The first task is to determine the spatial and temporal distribution of juvenile sockeye within Lake Wenatchee, in order to assess the potential for interaction with hatchery coho smolts during the coho out-migration. The distribution of sockeye fry within the lake is determined by beach seining, snorkeling in the littoral zone, and tow-netting within the limnetic or pelagic zone. The route hatchery coho take through Lake Wenatchee and the amount of time they take to do so are being analyzed using radio-telemetry. A study of coho smolt predation on sockeye follows these baseline studies.

Studies began in 2001, with limited results. They are expected to continue through 2003. See section 11.1.1.

Coho Salmon Predation on Bull Trout

Potential for coho predation on young-of-the-year bull trout would be limited due to the lack of geographic overlap between bull trout spawning and rearing areas in the Wenatchee and Methow basins and proposed coho acclimation and release sites (Table 3). All proposed acclimation sites in the Wenatchee and Methow are lacustrine-type habitats that generally are not used by juvenile bull trout. In any event, bull trout tend to stay on the spawning grounds until they are large enough not to be a prey-sized item for coho smolts. Significant spatial overlap between the two species may occur in the long term if coho return to spawn upstream of their acclimation sites in significant numbers. Conversely, coho might also benefit bull trout in the long run as coho juveniles probably would become prey for adult bull trout.

Specific coho release sites have not been identified in the Entiat basin and studies are not proposed under this plan. If coho reintroduction is eventually initiated in the Entiat basin, two of the three target rivers (Entiat and Mad) contain bull trout (see section 2.2.1). In particular, the Mad River is considered a stronghold for bull trout by the USFS (USDA FS 1996). In the Entiat, the presumed spawning area for bull trout is within a mile of Entiat Falls (WDFW 1998). Downstream of the falls, which is a barrier to fish, lower gradients, higher temperatures and the presence of rainbow trout and chinook salmon suggest that the habitat may be unsuitable for bull trout spawning and initial rearing. In the Mad River, known spawning occurs in the upper middle reach, most above Cougar Creek (WDFW 1998). At this time, the potential for coho predation on bull trout in the Entiat basin is unknown but expected to be minimal, due to limited micro-habitat overlap and late emergence timing of juvenile bull trout. In fact, because bull trout are better predators than coho, it is much more likely that coho (naturally produced and hatchery) will become prey for bull trout, benefiting the bull trout population, rather than the other way around.

In summary, direct predation by coho smolts on other species is expected to be low either because coho would be actively migrating downstream and therefore be moving quickly away from other species' rearing areas; because habitat overlap is minimal; because fish densities in the habitat are low; or because coho would be too small to prey on other species. While some

risk to spring chinook needs to be imposed in order to study the potential for long-term risk to sensitive species, implementing the following mitigation measures as appropriate would minimize that risk:

- working with other fish managers to determine release sites and numbers that minimize risk but that also meet research objectives;
- releasing coho smolts in low densities;
- attempting to release fish that more closely resemble sizes of wild coho, which tend to be smaller than hatchery fish¹ (our target size of 20-25 fpp equates to 110 – 120 mm);
- ensuring smolts are ready to actively migrate before volitionally releasing them from acclimation ponds; and
- monitoring predation and adapting feasibility studies and activities as necessary to minimize risks.

Competition

By definition, competition is a situation where the use of a common and limited environmental resource by two individuals or species causes the growth or survival of one individual or species to be reduced due to the shortage of this resource (Whittaker 1975). Direct competition for food and space between hatchery coho and other species can result in displacement of other fish into less preferred areas, which can potentially affect their growth and survival. For competition to have an adverse effect, the same limited resource must be used by more than one species. However, in some instances, competition for space and food may clearly alter patterns of microhabitat utilization while having no effect on productivity or viability (Spaulding et al. 1989). Indeed, the small-scale shifts in use of habitat niches may represent a significant benefit at the community level because environmental resources are used more efficiently (Nilsson 1966).

Juvenile coho salmon are known to be highly aggressive compared to other juvenile salmonids; thus they may compete with hatchery or naturally produced spring and summer/fall chinook, steelhead or rainbow trout, and resident fishes under certain conditions. For example, in a study conducted by Stein et al. (1972) in an artificial stream, coho socially dominated **fall chinook**, and fall chinook grew faster alone than with coho present. However, Lister and Genoe (1970) suggested that coho and fall chinook do not interact in the natural environment because of size-related differences in microhabitat selection. Coho salmon displaced **summer chinook** from preferred microhabitats in the Wenatchee River drainage but did not measurably affect their growth or survival (Spaulding et al. 1989). YN snorkeling surveys, as discussed under “Predation” above, showed that spring chinook and coho use different microhabitats (Dunnigan and Hubble 1998). Groot and Margolis (1991) also suggest that there is little habitat overlap between chinook and other salmonids including coho and sockeye, and that this habitat segregation provides a possible mechanism for reducing ecological interactions between the species.

¹ Throughout the geographic range of coho salmon, length at smoltification is relatively consistent. Groot and Margolis (1991) reported that mean smolt size in yearling smolts ranged from 75 (Andersen and Narver 1975) to 122 mm fork length (McHenry 1981), and smolt size in Minter Creek, Washington ranged from 95-106 mm (Salo and Bayliff 1958).

Coho salmon have been shown to displace **cutthroat trout** from pool habitat into riffle habitat (Glova 1984; 1986; 1987; Bisson et al. 1988), even though both species preferred pool habitat in the absence of the other species. Tripp and McCart (1983) observed increasing negative impacts on cutthroat trout growth and survival as coho stocking densities increased.

Coho salmon and **rainbow/steelhead trout** are reported to share habitat along the western coast of North America from California to British Columbia (Frasier 1969; Hartman 1965; Johnston 1967; Burns 1971), with both species residing in freshwater for extended periods (Groot and Margolis 1991). However, the reported impacts of the presence of coho salmon on rainbow/steelhead trout are conflicting. Frasier (1969) observed that the survival rate of steelhead living sympatrically with coho salmon declined slightly as coho salmon densities increased. Coho were shown not to affect steelhead growth or habitat use in the Wenatchee River (steelhead occupied different microhabitats than salmon) (Spaulding et al. 1989), and coho affected steelhead habitat use only to a small extent in another Washington stream (Allee 1974, 1981). However, Hartman (1965) concluded that strong habitat selection occurred in the spring and summer as a result of aggressive behaviors which were differentially directed by coho against steelhead in pools and by steelhead against coho in riffle habitats.

Coho salmon may have a competitive advantage over steelhead when they coexist. Juvenile coho salmon tend to emerge from the gravel earlier than steelhead, which allows them to establish territories and reach larger sizes than steelhead of the same age class (Berejikian 1995). Both laboratory and stream studies indicate that these species use different stream microhabitats. In the absence of coho salmon, steelhead use more of the water column and more pool habitat than when coho salmon are present (Hartman 1965, Allee 1974, Bugert and Bjorn 1991). In the presence of coho salmon, age-0 steelhead generally occupy the shallower, faster water of riffles and pool slopes, while coho salmon occupy the deeper water of pools (Bugert et al. 1991).

The segregation of these species appears to be both actively maintained and adaptive (Nilsson 1966). Their habitat segregation is consistent with inter-specific morphological variation: juvenile steelhead are more fusiform in shape than coho salmon and therefore better able to cope with higher water velocities (Bisson et al. 1988). These differences may reduce competition and facilitate partitioning of stream resources during low summer flows in streams when competition is most intense (Hard 1996). Because of their different morphology and habitat use, it is expected that stream characteristics will be primary determinants of interactions between these species: steelhead are expected to thrive better in the presence of coho salmon in streams with higher gradients and velocities, while steelhead are likely to diminish in streams with lower gradients and velocities (Hard 1996); Stelle 1996).

In 1998, the YN conducted field experiments to address the impacts of coho on the growth, abundance, and broad-scale geographical displacement of cutthroat and rainbow/steelhead trout. Researchers found no evidence that coho salmon influenced the abundance of cutthroat or rainbow trout when they compared the abundance of each species at sites where coho were stocked as well as where coho were not stocked. Coho abundance was largely related to stocking location. In addition, they found no evidence that coho affected the growth of cutthroat or rainbow trout when they compared the condition factor of each species in areas with and without coho (Dunnigan and Hubble 1998). These streams were generally characterized as relatively high gradient (2-5%), and ranged from second- to third-order streams.

Researchers were unable to locate any studies that investigated competitive interactions between **bull trout** and coho salmon. However, Underwood et al. (1992) investigated competitive interactions between hatchery steelhead and spring chinook juveniles and juvenile bull trout and concluded that competition between these species of hatchery fish and bull trout was not affecting abundance of bull trout or their use of microhabitats.

Little competitive interaction is expected between bull trout and coho smolts released in the mid-Columbia tributaries. Bull trout typically spawn in tributaries to the Wenatchee and Methow Rivers, or in the middle to upper reaches of the Entiat and Mad rivers. Spawn timing in these tributaries is most likely similar to general patterns observed for the species, is related to water temperature and generally occurs from September to October (Pratt 1992). Spawning and rearing of bull trout is thought to be primarily restricted to relatively pristine and cold streams, often within the headwater reaches (Rieman and McIntyre 1993). The geographic overlap of the juvenile bull trout rearing habitat and the coho migratory path would be minimal for coho releases because the majority of juvenile bull trout rearing habitat is believed to occur upstream of proposed (or likely, in the case of the Entiat River) coho acclimation sites. Sites proposed in the future for the Mad River would take into account known bull trout spawning locations. Any opportunity for interaction with bull trout juveniles would be further limited due to the migratory behavior of coho smolts.

No published studies were found that demonstrated complete competitive exclusion (species extirpation) by coho of any species.

Rapid out-migration of hatchery fish is believed to decrease the risk of ecological interaction to wild fish (Steward and Bjornn 1990). Recent studies in the Yakima basin found that, on average, actively migrating PIT-tagged coho smolts migrated approximately 30.1 km (18.8 miles) per day. The later the fish were released and the higher the volume of water flowing in the river, the faster the fish moved. Migration rates for coho released in the mid-Columbia tributaries are expected to be similar.

Competition that results directly from the release of hatchery coho smolts would likely be negligible due to the fact that coho would be actively migrating downstream and therefore have limited time to interact with individual fish species. Implementing the following mitigation measures (which are similar to those for minimizing predation) as appropriate would minimize the risk further:

- releasing coho smolts in low densities;
- avoiding or delaying releases in habitat for sensitive species (except when the point of the research is to test interactions with a specific species or when YN and the TWG mutually agree such releases would be appropriate);
- attempting to release fish that more closely resemble sizes of wild coho, and
- ensuring smolts are ready to actively migrate before volitionally releasing them from acclimation ponds.

Coho will be released at levels that meet project goals and that will produce naturalized coho at levels consistent with the carrying capacity of the natural habitat (Table 10). From the one million coho smolts proposed to be released into the Wenatchee River basin in the next few years, approximately 1,000 returning adults are expected. Until 2003, a maximum of 380 coho

are expected to spawn naturally near release sites; that number is approximately 6% of the historic population (6,000 - 7,000) in the basin.

Current carrying capacity of tributaries in the mid-Columbia is likely lower than historically for all species of salmonids, and therefore, competition between two species might still be severe at densities below the historic carrying capacity of the habitat. However, while estimating current carrying capacity is imprecise at best, estimates provided in Table 10 suggest that the coho escapement proposed under this plan would not threaten other species in the near term. In fact, in 2001, only three coho redds were found in Nason Creek downstream from the release site.

If the project moves beyond feasibility studies and stocking or natural production significantly increases coho densities, the risk of adverse competition effects could increase. Project participants plan studies that will help assess the potential for inter-species competition, beginning with spawning ground surveys in fall 2001; habitat use by sub-yearling coho, spring chinook, and steelhead in summer 2002; and radio-telemetry studies in fall 2002/2003 (see section 11.1.1). It is expected that such studies would inform future decisions on release numbers and escapement goals for the long term. The challenge will be to make competition studies meaningful with the limited numbers of naturally produced coho expected in the near term.

Residualism

The spatial and annual incidence of residualism—the tendency of hatchery smolts to delay or avoid what otherwise would be normal outmigration in the spring—can be variable. When fish residualize, they become a part of the stream-reared fish community; they could potentially compete with resident fish for resources such as food and space and become potential predators (or prey).

To help determine the incidence of coho residualism, YN conducted snorkeling studies in 1999, 2000, and 2001 in Nason Creek; in 2000 in the Wenatchee River; and in 2000 and 2001 in the Methow River. Rates of residualism in Icicle Creek and the Wenatchee and Methow rivers were low. Few residual coho were observed during 1999 snorkel surveys in Nason Creek. During a complete survey (100% sample rate) between Swamp Creek (RM 4.5) and the mouth of Nason Creek, 8 (0.01%) coho were observed (Dunnigan 1999). No coho were observed in Nason Creek in 2000, but it is likely that the numbers of residual coho were too low to be detected with the 20% sample rate used. Similarly, no residual coho were observed in Nason Creek during the 2001 surveys, even though the sample rate was increased to 25%. If the relative abundance of residual coho in Icicle Creek (0.002%) were applied to the 75,000 smolts released into Nason Creek, it would result in approximately 1 to 2 residual coho (Murdoch and Dunnigan 2001).

Based on the 1999 observations and the 2000 estimates in Nason Creek, and previously reported rates of coho residualism in the Yakima River (Dunnigan 1999), we believe that the proportion of hatchery coho that do not migrate during the spring is low. Recent experience with mid-Columbia coho releases shows that when researchers remove the barriers at coho acclimation sites, the fish leave quickly. The incidence of coho residualism is expected to be minimized through acclimation and volitional releases. Based on these results, the Technical Work Group deemed further residualism studies unnecessary.

Straying

At the start of feasibility studies, straying of Lower Columbia fish back to their natal hatchery (thus increasing competition with local populations) was not expected to be an issue. Johnson et al. (1990) found that coho smolts acclimated for similar periods used in our study (up to six weeks) strayed back to their natal hatchery at a rate less than 0.001% when released from another river system. Beginning in 2002, 100% of coho smolts released will be marked, thus allowing lower Columbia River hatchery managers to monitor strays of adult project fish to hatcheries where they were reared.

In the mid-Columbia region, returning coho have been observed spawning in tributaries to the Wenatchee where they were not released (Peshastin and Chiwakum), as well as in the Entiat River and Chelan Falls. YN proposes a radio-telemetry evaluation to collect data on stray rates of project fish in the mid-Columbia (see section 11.1.1).

In sum, broad geographical displacement and reduced survival of other salmonid populations is not expected because:

- 1) coho released during the period covered by this plan are expected to migrate quickly and therefore limit the risk of competition with other species;
- 2) studies have shown little residualism among hatchery coho smolts;
- 3) numbers of naturally spawning and rearing coho are expected to be well below the carrying capacity of the target streams;
- 4) the incidence straying and the numbers of naturally spawning fish would be monitored as carefully as technology allows; and
- 5) release numbers or rearing practices would be modified if necessary to limit effects on sensitive species.

Transfer of Disease

In general, artificially propagated fish are more prone to suffer from infectious diseases and parasites than their wild counterparts because they live under unnaturally crowded conditions where transmission of infectious agents is more efficient. In addition, hatchery rearing conditions and artificial diets may result in stress or nutritional imbalances that affect the physical condition of hatchery fish and their resistance to disease organisms. Concerns have been raised in the past that such diseases could be transmitted from hatchery-reared coho to wild fish of other species, thus increasing the incidence of infection among wild stocks.

The presumed risk is from two sources: first from hatchery coho smolts released into these locations and later, from adult fish returning to spawn. Upriver salmonids have been documented holding in the lower reaches of lower Columbia River tributaries where they may become exposed to infectious agents in that sub-basin and later show overt disease when they arrive at their upriver “home.” Using genetic “fingerprinting” methods, researchers have documented the movement of strains of infectious agents within the Columbia River basin that are believed to be due to the migration of adult salmonids (Jim Winton, USFS, personal communication, 1999).

Because anadromous fish are already in the subject watersheds and because coho salmon are more resistant than steelhead or chinook salmon to many of the viral and bacterial pathogens of concern, the added risk from this source seems limited. Virtually all of the infectious diseases affecting hatchery coho salmon in the Columbia River basin are thought to occur in wild fish or in the natural environment. Most Columbia basins have or have had the major diseases of concern. For example, BKD is prevalent in essentially all hatchery and wild stocks of salmonids in the Columbia River basin (Jim Winton, USGS, personal communication, 1999).

A literature review by Miller et al. (1990) found that, in spite of the comparatively high incidence of disease among hatchery stocks, there is little evidence that diseases or parasites are routinely transmitted from hatchery to wild fish. This review found a number of studies indicating that bacterial kidney disease was *not* transmitted from infected hatchery outplants.

Among the normal suite of viral, bacterial, fungal and protozoan diseases known to infect salmonids in the Columbia River basin, the most important for coho is coldwater disease. Coldwater disease is a significant risk to coho, particularly in the higher-elevation tributaries of the mid-Columbia basins. Depending on fish life stage and specific rearing conditions, when water temperature in the hatchery cools in the fall and winter, potentially lethal bacterial outbreaks can develop. The disease is treated using antibiotics, but it is not always effective. Because the causative bacterium is already free-living in the watershed, other salmonids in the basin might not be placed at significantly greater risk from this disease due to the presence of coho.

Hatchery-reared fish are prone, through proximity, to contract a variety of fungal, protozoan, and helminth parasites that are relatively easy to diagnose, and chemical treatment of the holding water normally is effective. Any potential risk of transmitting most internal and external parasites of salmonid fish from hatchery to wild situations would be confined to the brief period during outmigration and would therefore be limited.

All phases of broodstock development, fish transfers, and smolt releases would follow the fish health policy documented in *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries* (IHOT 1995(a)). Rigorous sanitation and use of disinfecting procedures combined with optimum husbandry, isolation and quarantine practices and a strong diagnostic and therapeutic program would minimize fish health concerns and reduce any potential for adverse effects from disease transmission by released coho to a low risk.

Migration Corridor/Ocean

Little is known about the effects of hatchery fish on listed fish in the migration corridor and ocean. Studies have shown that a significant portion of all hatchery fish released into the Columbia River basin do not survive the Snake and Columbia River migration corridors, for a variety of possible reasons (NMFS 1999(b)). In an attempt to address potential ecological effects of hatchery fish on listed fish in the migration corridor and ocean, NMFS has recommended an annual production ceiling for the Columbia and Snake rivers. NMFS determined, in its Biological Opinion on the project, that the proposed 1999 coho salmon release was consistent with its Columbia River basin production ceiling and that it would not jeopardize the continued existence of listed salmon and steelhead in migration corridors, the estuary, or the ocean (NMFS 1999(b)). The total release numbers have not changed since 1999, so the 1999 determination is assumed to be still valid.

SECTION 4. WATER SOURCE

To begin to develop a locally adapted coho population, the project is using existing hatcheries that have space available and no conflicts with existing programs. Where possible, these facilities are in mid-Columbia basins. So far, however, capacity in the region is not sufficient to accommodate project needs. Winthrop National Fish Hatchery on the Methow River is being used for part of the broodstock development, but ideally another hatchery in or near the Wenatchee basin is needed to meet broodstock development and egg quality goals. Beginning in 2002, Entiat NFH will be used for adult holding, spawning, and egg eye-up only. Full term rearing is not available at this time but could be an option if resource managers reduce or eliminate Entiat NFH spring chinook production for ESA reasons.

Primary rearing facilities:

Winthrop NFH – Water rights total 29,930 gpm from the Methow River, Spring Branch Spring and two wells. Water use ranges from 8,528 to 27,686 gpm, with the Methow River providing the majority of the flow. All rearing facilities are normally supplied with single-pass water; however, some serial re-use occurs in low-flow years (USDI FWS n.d.). The water supply at Winthrop NFH has frozen in the past. If that were to happen again, any coho at the hatchery would be released into the environment.

Lower Columbia River rearing facilities:

Willard NFH – see USFWS documents for water supply details.

Cascade (ODFW) – see ODFW documents for water supply details.

Adult holding facilities:

Entiat NFH – water rights total 15,340 gpm from three sources: the Entiat River, Packwood Springs, and wells. Approximately 7,786 gpm is available for hatchery use. The Entiat River and wells provide most of this water flow.

Leavenworth NFH – water rights total 25,551 gpm from wells, Icicle Creek, and Snow and Nada lakes. Average flow available to the hatchery is 18,170 gpm. There is insufficient water to operate all rearing facilities. Water from Snow and Nada lakes supplement Icicle Creek during low flow periods.

Chiwawa (WDFW) – see WDFW documents for water supply details.

Approved or proposed acclimation/release sites as of spring 2002:

Dam 5 – Icicle River [not expected to be available after 2003].

Little Wenatchee (Two Rivers) – Pumped ground and/or gravel pit water, discharged to the Little Wenatchee River (revised location since 2001, subject to environmental review).

Butcher Creek – Butcher Creek, tributary to Nason Creek.

Early Pond – Unnamed creek, tributary to Nason Creek.

Whitepine – Unnamed creeks, tributary to Nason Creek (subject to environmental review).

Beaver Creek – Beaver Creek, tributary to the Wenatchee River.

Eightmile Creek – Eightmile Creek, tributary to the Chewuck River.

Biddle Pond – Wolf Creek, tributary to the Methow River.

Other potential sites are being identified and, if proposed, will be subject to various environmental and TWG reviews before being used.

SECTION 5. FACILITIES

Section 1.5 describes the locations of physical facilities required for this feasibility study. No permanent hatchery will be built for these studies. Most facilities proposed for use already exist. The exceptions include some acclimation sites and a potential temporary production facility if existing facilities cannot be used. Impacts of construction and use of currently known acclimation and temporary production facilities are described in the following documents:

- *Mid-Columbia Coho Reintroduction Feasibility Project, Final Environmental Assessment and Finding of No Significant Impact* (USDOE/BPA 1999(b)) and *Supplement Analyses* (USDOE/BPA 2001(b) and USDOE/BPA 2001(d));
- Biological Assessment for Mid-Columbia Coho Reintroduction Feasibility Project, Chelan and Okanogan Counties, Washington (USDOE/BPA 1999(a));
- Biological Assessments prepared for USFWS in March 2001 (USDOE/BPA 2001(a)) and for NMFS and USFWS in August 2001 (USDOE/BPA 2001(c)).

5.1) Broodstock collection facilities (or methods).

Coho returning to the Wenatchee River Basin might be collected at one or more of the following facilities: Dryden Dam, Tumwater Dam, Dam 5 and the ladder at Leavenworth NFH, and Columbia River mainstem dams. For the Methow River, coho will be collected at Wells Dam and at the Winthrop National Fish Hatchery. If insufficient broodstock are trapped in the mid-Columbia sites listed, then Prosser Dam at RM 40 on the Yakima River may be used as an alternative to meet broodstock collection goals, rather than making up deficits with lower Columbia River fish. Prosser Dam is a coho broodstock collection site for the Yakima River coho restoration program. See section 7.2 for more detail.

5.2) Fish transportation equipment (description of pen, tank truck, or container used).

Adult coho are transported in a 930 gallon insulated stainless steel fish transportation tank. The tank is equipped with four microbubble ceramic plate oxygen diffusers and two aerators. In addition to the large transportation tank, a limited number of adult coho may be transported in a 200 gallon insulated fish tote equipped with one or two oxygen diffusers.

Coho smolts typically are hauled from lower Columbia River hatcheries to various acclimation sites in mid-Columbia basins by Oregon Department of Fish and Wildlife (ODFW). Fish are transported in 1,500-5,000 gallon (6,000-19,000 liter) transport tanker trucks. These units are insulated and typically maintain sub-50°F (<10°C) hauling temperatures and strive for no more than a 10°F (6°C) (<5°F preferred) variation between tank temperature and release site temperature. Transport tanks are equipped with oxygen injection and water circulation systems. Dissolved oxygen levels are maintained at 9-15 ppm. Oxygen and temperature levels are monitored during transports. Hauling

densities are targeted at or below 1 pound of fish per gallon of water. Length of transport ranges from 6-8 hours.

5.3) Broodstock holding and spawning facilities.

All coho collected at Dryden Dam, Tumwater Dam, and on Icicle Creek will be transported by Yakama Nation personnel to Entiat National Fish Hatchery. The adult holding ponds at ENFH will be used as a holding facility until all the fish are spawned. End dates will be determined each year in consultation with facility operators.

Fish collected at Wells Dam will be transported to Winthrop NFH for holding and spawning.

5.4) Incubation facilities.

Leavenworth NFH – Coho eggs are incubated in Marisource stack incubators with 6,000-6,500 eggs per tray. Total incubation capacity for coho at the LNFH is 720,000 eggs. The hatchery uses ground water and effluent is UV-sterilized prior to discharge.

Peshastin incubation facility – Two deep trough incubators were used for brood year 2001. Each trough contained 4 incubation cells. Chilled water was supplied to each incubator. Total incubation capacity at the Peshastin facility (a temporary facility at a former fruit warehouse) was approximately 864,000 eggs.

Entiat NFH – A total of three deep trough incubators supplied with chilled water will incubate coho eggs at the ENFH. Maximum incubation capacity at ENFH will be 1,728,000 green eggs.

Cascade Hatchery (ODFW) – Eyed eggs transported from green egg incubation sites will be hatched in existing facilities.

Willard NFH – Eyed eggs transported from green egg incubation sites will be incubated and hatched in existing facilities.

Winthrop NFH. – Normally eggs are incubated from adults spawned at the hatchery. If there is a shortfall in the target numbers for this hatchery using eggs from adult returns to the Methow, eyed eggs transported from lower river sites will be incubated and hatched here.

5.5) Rearing facilities.

Mid-Columbia brood eyed-eggs not reared in the region will be transported to lower Columbia River fish hatcheries for rearing. These hatcheries may include Cascade FH (ODFW) or Willard NFH. Please refer to HGMPs for these facilities for information on rearing conditions.

5.6) Acclimation/release facilities.

Figures 2 and 3 show locations of existing and known potential acclimation sites, listed below. Currently, coho pre-smolts are acclimated in semi-natural ponds or river side channels behind Dam 5 on Icicle Creek and at Butcher Creek, Beaver Creek, and Early Pond in the Wenatchee basin; and at Winthrop NFH in the Methow basin. Additional sites are proposed in the Wenatchee basin for 2002 and beyond. The program will lose use of the Dam 5 site after 2003.

In the Wenatchee basin, specific acclimation and release sites in Chumstick and Brender creeks, a replacement for acclimation at Dam 5, and additional sites in Nason Creek have not been approved, although some options have been identified. Additional sites in the Methow beyond those identified in the 1999 EA have not been proposed. No specific sites in the Entiat basin are currently proposed. Before new, additional, or replacement sites are developed, they would be subject to NEPA and/or ESA review of site-specific impacts.

Wenatchee basin

- Dam 5 – an impoundment formed in the Icicle River channel by a dam. Fish screens added to the dam confine coho during acclimation.
- LNFH – above-ground temporary metal framed ponds or unused Foster/Lucas cement ponds. Potential replacement for Dam 5.
- Little Wenatchee (Two Rivers) – a proposed site at an operating gravel pit that will require construction of an earthen pond and a pumped water supply.
- Butcher Creek – an existing beaver pond with an outlet barrier added.
- Early Pond – an existing pond formed during construction of Highway 2. An outlet screen is fitted to an existing culvert to confine fish.
- Beaver Creek – an existing pond adjacent to Beaver Creek with inlet and outlet screens added to confine fish and regulate water flow.
- Whitepine – two proposed sites near the Whitepine campground. One is an existing pond on private land that would require a net barrier. The other is an existing beaver pond on USFS land that would need minor road improvements and a net barrier.
- Brender – an existing pond that will require the addition of a downstream barrier.
- Coulter Creek – an existing pond in the Nason Creek watershed proposed for use in 2003, requiring installation of an outlet pipe through a beaver dam and barrier nets.
- Mahar Creek Pond – an existing pond in the Nason Creek watershed proposed for use in 2003, requiring installation and removal of barrier nets.

Methow basin

- Eightmile Creek – an existing series of ponds with fish screens in place.
- Biddle Pond – an existing pond with fish screens in place.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.

Coho reared at Winthrop NFH experienced an unusual botulism problem in 2001, after their rearing location was changed due to the extremely low water that year. The rearing location has been moved to inside the hatchery. There was no reported loss from botulism in natural or hatchery populations of other species. This problem is not expected to recur.

5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

Coho are not listed in these basins.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

6.1) Source

Because coho salmon have been extirpated in the Wenatchee and Methow basins, the research into the feasibility of reintroducing the species relies on development of a coho broodstock from lower Columbia River populations. No wild stock from the mid-Columbia exists to use, and wild stocks from other areas such as British Columbia currently are unavailable. The domesticated Lower Columbia River stock (which originated from the Toutle River stock, with recent infusions of Sandy River stock) is being used as initial broodstock. These fish would come as smolts from Willard or Cascade hatcheries. In 2000, 700,000 smolts came from Cascade and 400,000 from Eagle Creek, but Eagle Creek is no longer used as a source. The numbers from each hatchery are negotiated annually, but the fish are from essentially the same stock regardless of which of the three lower river hatcheries they come from.

Beginning in 1999, adult coho returning to the mid-Columbia from earlier releases in the Methow basin were collected at Wells Dam and Winthrop NFH for use as broodstock. Other collection points were added in later years (see section 1.5). Projected numbers of returning adults to be collected in 2002 are shown in Tables 14 and 15 (section 7.4). Broodstock collection goals are developed annually. As adult returns increase, the project will rely less on the Lower Columbia River stock.

To maximize the potential for genetic variability and naturalization of the returning population, the project would initially use most of the returning coho for broodstock, collected throughout the run. Hatchery fish that return to the mid-Columbia will have gone through a substantial selection process to survive the long migration and the variety of obstacles they encounter in the journey, which is expected to enhance the trend toward local adaptation.

Ideally, adults collected at Wells Dam would be used to develop a Methow basin broodstock, and adults collected at Dryden or Tumwater dams would be used to develop a Wenatchee basin broodstock. However, the number of adults returning is likely to constrain the program from meeting the ideal for much longer than the scope of this plan. For this period, in general, Wenatchee returns are incubated at Entiat NFH and then at lower river hatcheries and returned to the Wenatchee for acclimation. Methow returns are spawned and reared at Winthrop NFH, to the extent of their capacity. The localized stocks are supplemented with progeny of lower Columbia River hatchery stocks if necessary to meet production numbers. Release guidelines are specified in section 10.4.

6.2) Supporting information

6.2.1) History

The Lower Columbia River stock has been essentially a hatchery stock since the 1960s and is considered domesticated. The original source of the Lower River stock was the Toutle River stock. The LCR stock also has had recent infusions of Sandy River stock.

Ninety Years of Salmon Culture at Little White Salmon National Fish Hatchery (Nelson and Bodle, 1990, pp. 12-18), describes the early history of the Lower River stock. Tables 12 and 13 show more recent history.

Initial attempts to rear coho salmon with the native, late-running stock were made in 1919 and 1922. Attempts in 1930 and in the 1950s involved early-running stocks native

to the Quinault, Quilcene, and Dungeness rivers of Puget Sound, Washington, as well as a native Toutle River stock. The Toutle River stock was considered responsible for establishing a successful run in 1956. In 1957 and 1958, eggs from Little White Salmon NFH were shipped to Willard NFH for incubation, after which the fry were returned for rearing. Additional eggs of the Toutle River stock were received from Eagle Creek NFH in 1962 and Bonneville State Fish Hatchery (SFH) in 1963.

Initially, these fish were released in their first summer; later, they were usually released as yearlings in February or March. Fish reared at Little White Salmon NFH were also shipped to Spring Creek, Eagle Creek, Carson, and Willard NFHs for finishing and distribution; others were released in the Columbia, Snake, Klickitat, and John Day rivers...

By 1965, a dependable run of Toutle River coho salmon stock was established... Increasingly larger numbers of eggs were moved to Willard NFH, until finally the Little White Salmon facility began serving its present function as an egg-taking station for Willard NFH. Eggs were also shipped to Entiat, Winthrop, Leavenworth, Carson, and Coleman NFHs; Washougal SFH; and [to other states and countries].

Table 12. Coho Genetic History at Eagle Creek Hatchery

Originally at hatchery beginning:	
BY '57	400,000 from Sandy River 200,000 from Little White Salmon NFH (Toutle)
BY '58	600,000 from Sandy River 467,000 from Big Creek
Since 1987 (released from ECFH):	
BY '88	325,000 from Sandy River, released April '90
BY '90	292,000 from Sandy River, released April '92
BY '91	196,000 from Sandy River, released April '93
BY '93	579,000 from Toutle River, released May '95

Table 13. Willard NFH Coho Salmon Fish/Eggs Received From Other Hatcheries 1985-1999

Date	Number	Received From
01/28/94	187,556	Speelyai SFH, WA
12/04/94	589,433	Lower Kalama SFH, WA
12/24/96	883,000	Cascade SFH, OR
02/19/97	886,413	Bonneville SFH, OR
03/17/97	948,592	Klaskanine SFH, OR
06/12/97	268,002	Eagle Creek NFH, OR

6.2.2) Annual size

Broodstock collection of mid-Columbia adults began in 1999 at Wells Dam and Winthrop NFH. Table 1 (section 1.11) shows numbers of fish collected in each basin. In 2000, we estimate that 1,113 coho returned to the Wenatchee River Basin; of these, we trapped 919. We observed a pre-spawn mortality rate of 9.5% (87 fish). Based upon 2001 dam counts (Rock Island minus Rocky Reach), 8,555 adult coho returned to the mid-Columbia River and Wenatchee River Basin. This gives us a 0.86% survival rate. Based on numbers of coho collected further upstream at Dryden Dam and in Icicle Creek, Tumwater Dam video counts, redds in Icicle Creek, and coho carcasses collected in the Wenatchee River, 1,730 coho were known to return to the Wenatchee River basin and spawn, providing a minimum smolt-to-adult survival for the Wenatchee River of 0.16%. We collected 1,240 coho for broodstock in the Wenatchee River Basin in 2001.

Based upon Wells Dam counts, 536 coho returned to the Methow River in 2001. This gives us a 0.27% smolt-to-adult survival for the Methow River. Of the 536 coho counted at Wells Dam, 334 coho returned to the Winthrop National Fish Hatchery; 93 were females. Of the 334, 128 males were returned to the river to spawn naturally.

In future years, if too few adults return to maintain an effective population size, their numbers would be supplemented either by adding Lower River adults to the breeding pairs, by supplementing the next year's releases with Lower River smolts, or a combination of both.

6.2.3) Past and proposed level of natural fish in broodstock.

Currently, there is no natural population from which to collect broodstock. Once naturally reproducing coho salmon are re-established in mid-Columbia tributaries, natural fish will be incorporated into the broodstock, initially in their proportion to hatchery fish. As natural production increases, the percentage of naturally produced fish incorporated into the broodstock would be evaluated on an annual basis.

6.2.4) Genetic or ecological differences

There are no natural stocks of coho in the target area. Genetic studies will monitor divergence of natural spawners from hatchery broodstock if the project is successful at improving adult returns (see section 11.1.1).

6.2.5) Reasons for choosing

The primary reason for choosing Lower River broodstock to begin with is that it is the closest stock available geographically, and it is the only early stock in the Columbia River basin. For at least six years, the broodstock selection process would be entirely random, but as large a proportion as possible of the returning adults will be used in order to incorporate the characteristics that allowed the lower Columbia River fish to return to mid-Columbia basins. While the genetics monitoring program would study returning coho for traits associated with survival and adaptability, any proposal to select for certain traits in developing broodstock would be evaluated in future decision-making processes. See also section 6.1.

6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.

Because coho are considered extirpated from mid-Columbia basins, introduction of a Lower River stock would not affect a listed population.

SECTION 7. BROODSTOCK COLLECTION

7.1) Life-history stage to be collected (adults, eggs, or juveniles).

Adults.

7.2) Collection or sampling design.

Include information on the location, time, and method of capture (e.g. weir trap, beach seine, etc.) Describe capture efficiency and measures to reduce sources of bias that could lead to a non-representative sample of the desired broodstock source.

Wenatchee River Basin

To maximize genetic diversity we will collect a representative sample of returning coho from throughout the run. Based on experience in 2000 and 2001, we expect the first coho to arrive at Dryden Dam as early as the first week of September and to continue through early December. Migration peaks in mid-October. Weekly broodstock collection goals will be developed on an annual basis based on the average distribution of returning coho (Table 16 [section 7.4]). If, during any week, the broodstock collection goal is not met, the deficit will be carried over to the following week.

If we are unable to meet our weekly broodstock collection goals through trapping efforts at Dryden Dam, adult coho will be trapped concurrently at Tumwater Dam and Leavenworth NFH Dam 5 or ladders on the Icicle River.

- Dryden Dam: Broodstock collection at Dryden Dam will take place daily in coordination with Eastbank Fish Hatchery Complex personnel. Currently, YN provides two people (fisheries biologist and/or fisheries technicians) each day during the trapping period to assist in trap operations. Number of personnel required for trap operation will be re-evaluated with facility operators on an annual basis. If the weekly coho broodstock collection goals are met prior to the end of the week, YN personnel will continue to assist in the operations and

collections at Dryden Dam, to include enumerating and passing coho upstream. YN alone will operate the Dryden Dam fish trap after November 14th.

The Dryden Dam fish trapping facility is operated by WDFW and Chelan County Public Utility District (CPUD) personnel from July 5 through mid-November to collect steelhead and summer chinook broodstock. The trap normally is operated 24 hours a day, 5 days a week. BPA has proposed to extend the trapping period to December 7. This will help ensure broodstock are collected throughout the entire run.

To keep transportation stress to a minimum, no more than 65 adult coho will be collected and transported from Dryden Dam on any given day. Any coho in excess of 65 will be passed upstream.

- Tumwater Dam: Trapping efforts at Tumwater Dam will be coordinated with Eastbank Fish Hatchery personnel. Tumwater Dam trap normally is operated 3 days/week, 8 hours/day between July 19 and November 17th (Peterson 2001), although it is permitted to operate up to 16 hours a day. BPA has requested that operations be extended through December 7.
- Leavenworth NFH: If necessary, coho would be trapped at Dam 5 or the fishway, using both the right and left bank ladder traps. The trap could be operated between September 7 and December 7, by either YN or hatchery personnel.

Methow River Basin

Depending on run size, adult coho can either be trapped at Wells Dam and/or allowed to ascend the Methow River on their own. If insufficient numbers return to the Methow River basin, additional broodstock may be taken in the Wenatchee River basin to meet Methow basin project goals.

- Wells Dam: Beginning in fall of 1999, coho adults returning to the Methow basin were trapped at Wells Dam on the Columbia River. The dam is equipped with traps to collect adult fish. The traps are currently being operated by WDFW to collect steelhead adults, which would be returning at the same time as coho. Currently we allow coho adults to swim into Winthrop NFH rather than trap them at Wells. If the runs are predicted to be less than 150 coho for the Methow, we would trap at Wells as often as WDFW's permit (#1094) allows.
- Winthrop NFH: The Winthrop NFH fish ladder is opened on the first of October and allowed to attract and collect fish throughout the run. Coho swim directly into the hatchery. Because this is the only release site for coho smolts in the Methow basin, the coho are expected to be well-imprinted on the hatchery, resulting in good collection rates. Spawning generally begins during the last week of October and continues on a one-day-per-week basis for a period of approximately 5 weeks.

Sources of bias: The sources of bias are low at Tumwater and Wells dams and at Winthrop and Leavenworth hatcheries. The sources of bias at Dryden are unknown. Potential sources of bias may include fish size and ladder efficiency, particularly with regard to river discharge. Dryden is a low-head dam, so fish can jump over it during high flows.

7.3) Identity.

Describe method for identifying (a) target population if more than one population may be present; and (b) hatchery origin fish from naturally spawned fish.

The project will begin marking all hatchery fish with coded wire tags to distinguish them from any naturally produced fish that may return in future years. See section 11.1.1.

7.4) Proposed number to be collected:

7.4.1) Tables 14 and 15 show program goals for the Wenatchee and Methow basins for 2002. They are based on pre-spawn mortality, eye-up, and hatching rates observed during the 2000 and 2001 brood years. The program goals will be re-evaluated on an annual basis if eye-up, mortality rates, or sex ratios change.

Table 14. Wenatchee River Broodstock Collection Goals: 2002

Program Goal (smolts)	Egg-to-smolt survival rate	Green eggs required	Fecundity	Pre-spawn Mortality rate**	Adult Females Required	Total Broodstock Collection ***
1 million	.60	1.6 million	2750	.10	673	1464

* Based on projected egg-to-smolt survival rates observed in 2000 brood

** Observed pre-spawn mortality rate in 2000 and 2001

*** Assumes 54:46 male to female ratio as observed in 2001

Table 15. Methow River Broodstock Collection Goals: 2002

Program Goal (smolts)	Eyed-egg survival rate*	Eggs required	Fecundity	Pre-spawn Mortality rate**	Adult Females Required	Total Broodstock Collection ***
250,000	.70	357,143	2750	.10	144	497

* Based on projected egg to smolt survival rates observed in 2001

** Observed pre-spawn mortality rate in 2000 and 2001

*** Assumes a 71:29 male to female ratio as observed in 2001

Table 16 shows weekly broodstock collection goals for the Wenatchee basin in 2002. Weekly goals will be developed annually. In the Methow, the project captures all possible fish, but at some point might need to develop weekly goals.

Table 16. Weekly Coho Broodstock Collection Goals for Wenatchee Basin: 2002

Week ending	9/8	9/15	9/22	9/29	10/6	10/13	10/20	10/27	11/3	11/10	11/17	11/24	12/1	12/8	Total
Estimated % of run	0.1	1.6	7.2	10.9	12.3	20.2	10.5	9.9	12.8	6.5	3.7	2.0	1.8	.50	100
Broodstock collection goals	2	23	105	160	180	296	154	145	187	95	54	29	27	7	1464

7.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

See Table 1 (section 1.11) and section 6.2.2.

7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.

Fish collected in excess of broodstock needs at Dryden Dam will be passed upstream.

7.6) Fish transportation and holding methods.

Methow Basin: If adult fish are trapped at Wells Dam, they are transported by a 400-gallon tank truck in groups of 20 or less to the Winthrop NFH adult holding/spawning facility. The trip takes about an hour and a half. Also see section 8.3.

Wenatchee Basin (see tank description in section 5.2): Coho are transported from Dryden to Entiat in a 0.6% salt solution (by weight), and are released directly into the holding pond. The trip takes about 1.25 hours. All broodstock will be treated with a 167 ppm formalin drip as a fungal control measure. Initial treatments begin upon release of fish into the holding pond and will continue for three consecutive days past the last transfer of fish. Thereafter, fish are treated every two to three days or as needed to control fungus.

7.7) Describe fish health maintenance and sanitation procedures applied.

See section 7.6. The fish transportation truck is disinfected weekly.

7.8) Disposition of carcasses.

At Winthrop NFH, spawned carcasses are returned to streams in the upper Methow basin for nutrient enhancement. At Entiat NFH, fish might be injected with an anti-bacterium to keep them disease-free. In those cases, carcasses are buried on the hatchery grounds. Uninjected carcasses are returned to streams.

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.

Any listed fish caught in the traps would be removed and released immediately.

SECTION 8. MATING

8.1) Selection method.

Spawners will be chosen randomly from ripe fish once a week. Returns from mid-Columbia brood may be selected to mate with returns from Lower Columbia River (LCR) transplants or other mid-Columbia brood to eliminate crossing LCR returns with LCR returns.

8.2) Males.

Eggs will be fertilized with one primary male and one back-up male. Jacks (2-year-old males) will be randomly collected during broodstock collection in the relative proportion that they occur in the run and incorporated into the mating schemes.

8.3) Fertilization.

During fertilization procedures, we will follow a 1:1 mating protocol with a back-up male. In the event that five or fewer females are available for spawning on any single spawn date, the eggs from each female will be divided into 5 clutches, a different male fertilizing each clutch.

- **Leavenworth NFH, Entiat NFH and Peshastin incubation facility:** Green eggs will be transported to the incubation facility where fertilization will occur. After fertilization, Iodophor egg treatments will include a minimum of one 30-minute contact period prior to putting the eggs in the incubation trays.
- **Winthrop NFH:** A minimum of six persons is required to carry out spawning operations at the adult holding/spawning facilities. For actual spawning, two fish killers select and kill males and females from pre-sorted fish. One spawner strips eggs from the females into numbered plastic zip-lock bags, one bucket spawns the males into numbered plastic bags, one egg transporter carries coolers containing gametes to the hatchery building, and one person fertilizes and places the eggs in an Iodophor solution (75ppm) in the isolation incubation buckets. Further details on spawning methods can be found in the Winthrop NFH Fish Culture Manual.

Personnel from the USFWS Olympia Fish Health Center are present at most or all spawning days to collect viral and bacterial samples from the adults. They coordinate with the spawner and the bucket to get the proper amount of ovarian, blood, kidney, and spleen samples. After spawning, they immediately transport their samples back to the lab.

8.4) Cryopreserved gametes.

The program is cryopreserving gametes for a long-term genetics study. In 5-15 years, the project would use the gametes to determine if changes in genetic characteristics, run timing, or other behaviors result in measurable survival benefits.

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

The mating scheme will not affect listed natural fish, as coho are not listed in these basins.

SECTION 9. INCUBATION AND REARING

At the outset of the feasibility studies, final incubation and rearing of coho to smolts was done only in lower Columbia River hatcheries. The smolts were then trucked to mid-Columbia acclimation sites.

Beginning in 1999, Winthrop NFH began incubation and rearing of eggs and juveniles from adults returning to the mid-Columbia. They have the capacity to rear up to 250,000 smolts per brood year, with two brood years on station at a time. As stated in section 1.5, additional capacity in the region is needed to maximize the potential to meet program goals for broodstock development and smolt quality. In the Wenatchee basin, initial incubation takes place at the LNFH. LNFH does not have space to incubate the program's entire annual egg requirements; at this time, capacity for coho is limited to approximately 720,000 coho eggs. In 2001, coho eggs

in excess of 720,000 were incubated at a temporary facility housed in a fruit warehouse in Peshastin. Beginning in 2002, coho eggs will be incubated at the Entiat NFH and/or at the Peshastin facility, transferred to lower Columbia hatcheries at the eyed egg stage for rearing to pre-smolts, and then returned to mid-Columbia basins for acclimation and release.

Physical characteristics of the rearing environment and fish growth and health in those environments depend on the hatchery. All hatcheries currently involved in this project use appropriate IHOT protocols and standards, including those for health and disease monitoring.

9.1) Incubation:

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.

Provide data for the most recent twelve years (1988-99), or for years dependable data are available.

Table 1 in section 1.11 shows eggs taken and survivals since 1999. Tables 14 and 15 in section 7.4 show egg take goals and survival rates expected for 2002. Goals will be adjusted annually (see section 7.4).

9.1.2) Cause for, and disposition of surplus egg takes.

To date, no surplus eggs have been taken.

9.1.3) Loading densities applied during incubation.

Provide egg size data, standard incubator flows, standard loading per Heath tray (or other incubation density parameters).

See 9.1.4 below.

9.1.4) Incubation conditions.

Describe monitoring methods, temperature regimes, minimum dissolved oxygen criteria (influent/effluent), and silt management procedures (if applicable), and any other parameters monitored.

Incubation procedures at all sites will follow IHOT recommendations for flow rates, loading densities, *Saprolegnia* control treatments, and water quality conditions.

Incubation will occur at ground water temperatures; however, egg development will be retarded through the use of chillers in some cases. The purpose of this altered temperature regime will be to more closely match natural emergence times and to concentrate the range of time over which fry begin feeding in the hatchery.

Leavenworth NFH: The coho eggs are reared in an isolation unit (10' x 8' x 6') located inside the nursery building. This unit contains 8 Marisource heath incubator stacks with 16 trays per stack. To prevent silt build up, the top tray of each stack is not used, leaving 15 trays per stack for egg rearing. Each tray measures 15.5" x 12.5" x 2". Well water is provided to the incubator trays at a rate of 4 gallons per minute (gpm), with a temperature range of 45-48° F. Loadings are set at 2.5 females per tray, which is approximately 6,000-7,000 eggs. The maximum loading for the isolation unit is 750,000 eggs. Egg development is monitored using Daily Temperature Units (DTUs). The eggs remain in the Heath trays until they reach the eyed stage at approximately 500 DTUs. The eggs are then removed from the trays and shocked by pouring a basket of eggs from a height of 2 to 3 feet into another basket submerged in water. Twenty-four hours after shocking, the eggs are picked with a Jensor model H egg-picking machine. The following day the eggs are transported to another facility by Yakama Nation fishery staff.

Throughout the incubation period, the eggs are chemically treated to prevent fungus problems. Using a Masterflex peristaltic pump, a daily 15-minute dose of 1667 ppm formalin is pumped through ½ inch PVC pipe to the Heath incubators. Each Heath incubator stack has one micro-irrigation emitter, which is used to disperse the formalin treatment. Additionally, the isolation unit is equipped with an alarm system and a flow-through Ultra-Violet (UV) effluent treatment. The alarm detects any deleterious fluctuations in flow and/or temperature, and the UV system treats all effluent water from the isolation unit.

The LNFH staff maintain the incubators, temperature regime, and flow volumes and keep records on temperature units and egg numbers (eye-up).

Peshastin (2001): Groundwater is used for incubation. It has a CaCO₃ hardness of 73, a pH of 7.7, and an average temperature of 52° F. Water temperature is monitored with an onset temperature recorder, which measures temperatures hourly. Temperatures are maintained at approximately 41°F with a water chiller. The water is passed over a tote filled with bio-rings to ensure that adequate levels of dissolved oxygen and total dissolved gas are maintained prior to entering the incubators. Water is treated with activated charcoal and oyster shell prior to use in the incubators. Four gpm of flow is used per deep trough and the maximum green egg capacity per trough is 500,000.

Entiat NFH (2002 and beyond): Incubation facilities and conditions will be similar to those used in Peshastin in 2001.

Winthrop NFH: The eggs remain in the isolation incubation buckets until eye-up, which occurs approximately one month after spawning, or at 450-540 DTUs. After eggs are eyed, they are shocked and then picked by hand. Buckets containing a high mortality are picked with a mechanical egg picker.

After picking, and after receiving the Enzyme Linked Immunosorbent Assay (ELISA) results for each numbered bucket, the eggs are weighed and sampled on an electronic scale. A 200-500 egg sample is taken, to estimate the number per pound. Since coho salmon are quite resistant to bacterial kidney disease (BKD), eggs with differing ELISA values (lows, highs, and moderates) are tracked throughout incubation and rearing, but they are not isolated. After enumeration, the eyed eggs are placed in the Marisource stack-type incubator, using the 15.5" x 12.5" x 2" trays, 7 trays per stack.

Each tray is loaded with 4,000 eggs. Water flow is maintained at 3-5 gpm. Ground water is the primary incubation source and temperature remains quite constant in the range of 48 - 50° F. Dissolved oxygen levels are also constant at about 9.5 ppm inflow and not less than 8 ppm outflow.

Since fungus (i.e. Saprolegnia sp.) has not been a problem in the incubation of salmon and steelhead eggs at Winthrop NFH, formalin treatments are not required during incubation. Hatching begins after approximately 975 DTUs. Yolk sac mortality can be avoided by keeping incubation flows below 5 gpm. Significant yolk sac mortality has been observed in incubation units where flows exceed 6 gpm.

9.1.5) Ponding.

Ponding will occur after a majority have buttoned up (approximately 1375 temperature units). At ponding the coho will be approximately 1,100 fish per pound and

4 centimeters in length. Ponding will occur in February (Joe Blodgett, YN, personal communication).

9.1.6) Fish health maintenance and monitoring.

Regular iodophore treatments are the current method used to control fungus. Label regulations and recommendations are followed at all incubation locations. Eggs are shocked and picked after eyeing.

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.

Because coho are not listed, the primary concern would be disease transfer between coho and listed fish in any of the incubation facilities. There are no listed fish raised at Entiat NFH or Leavenworth NFH. At Winthrop, where spring chinook are raised, coho are kept in separate raceways and water used in coho rearing containers is not used for spring chinook.

9.2) Rearing:

The following information applies to the Winthrop NFH. It is representative of the rearing conditions at Willard, Cascade and additional production facilities that may be used in the future.

9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available.

Experience is limited at this point. Survival rates based on this limited experience are shown in Tables 14 and 15 (section 7.4).

9.2.2) Density and loading criteria (goals and actual levels).

Table 17 shows rearing facilities at Winthrop NFH.

Table 17. Rearing Facilities at Winthrop National Fish Hatchery

Unit Type	Unit Length (ft)	Unit Width (ft)	Unit Depth (ft)	Unit Volume (cu ft)	Number Units	Total Volume (cu ft)	Construction Material
Brood Ponds	80	40	6	19,200	2	38,400	Concrete
Marisource Incubators					42		Fiberglass
Raceways	80	8		1,300	30	39,000	Concrete
Foster Lucas Raceways	76	17		2,200	16	35,200	Concrete
Raceways	102	12		2,200	16	35,200	Concrete
Starter Tanks	16	3		120	34	4,080	Fiberglass
Troughs	16	1.33	1	21	8	168	Concrete

Swim-up fry are expected to be ready to come out of the stacks with full yolk absorption after 1800 DTU. The nursery is presently equipped with 34 fiberglass tanks. Every tank is thoroughly cleaned and then disinfected with approximately 2 ppm Hyamine between year-classes. The tanks have a total capacity of 100 cubic feet; rearing space per tank is approximately 89 cubic feet. The tanks accommodate a flow of approximately 30 gpm.

Ideally, 15,000 to 20,000 fry should be started per tank. However, at full production, initial loading of tanks may be closer to 30,000 fish per tank. Initial DI (Density Index) in past years has ranged from 0.05 - 0.41, and the FI (Flow Index) has ranged from 0.28 - 1.22. The target densities are similar to those used in steelhead rearing at this facility. The hatchery tries to keep the DI below .30 during early rearing (fry stage) and below .20 during later rearing (fingerling stage to smolt).

Since fry and fingerlings receive better cleaning and feeding, and treatable diseases are more easily observed in the hatchery building, fingerling spring chinook normally remain in the nursery until they are 200 - 300/lb. Coho salmon fry will also remain in the nursery until that size is reached unless space is not available.

9.2.3) Fish rearing conditions

Pond management strategies (e.g., Density Index and Flow Index) are used to help optimize the quality of the aquatic environment and minimize fish stress which can induce infectious and noninfectious diseases. For example, the Density Index is used to estimate the maximum number of fish (of a given length) that can occupy a rearing unit based on the rearing unit's size. The Flow Index is used to estimate the rearing unit's carrying capacity based on water flows.

The following parameters are currently monitored at Winthrop NFH:

- *Total Suspended Solids (TSS)* — 1 to 2 times per month on composite effluent, maximum effluent and influent samples. Once per month on pollution abatement pond influent and effluent samples.
- *Settleable Solids (SS)* — 1 to 2 times per month on effluent and influent samples. Once per week on pollution abatement influent and effluent samples.
- *In-hatchery Water Temperatures* — maximum and minimum daily.
- *In-hatchery Dissolved Oxygen* — as required by stream flow and weather conditions.

9.2.4) Indicate biweekly or monthly fish growth information (average program performance), including length, weight, and condition factor data collected during rearing, if available.

Table 18. Coho Growth Data (Average 1997-2001), Willard NFH

Month	Length Increase (inches)	Food Conversion	Water Temperature (F)
January	0.074	1.60	40.0
February	0.115	2.89	40.4
March	0.306	1.47	40.9
April	0.323	1.19	41.2
May	0.425	1.00	43.3
June	0.487	0.92	43.4
July	0.508	0.97	44.2
August	0.562	0.95	44.2
September	0.458	0.97	43.6
October	0.228	1.79	43.0

November	0.148	3.55	42.1
December	0.059	4.23	40.7

9.2.5) Indicate monthly fish growth rate and energy reserve data (*average program performance*), if available.

Winthrop NFH: At first feeding we generally start out at around 1.5% - 2% body weight per day until most of the fish are actively feeding. Feeding is spread out over 8 feedings each day. Once growth begins accelerating, feeding percentage is gradually decreased. Ground water in the nursery is quite constant at 47-51° F. At these temperatures we expect 50 Monthly TU/inch or about 0.33 inches per month. Once fish leave the nursery and begin rearing in raceways on river water, growth patterns change depending on temperature fluctuations. The following table illustrates average rates of coho growth in the first spring, and in the first and only fall on-station. The table includes averages from brood years 1999 and 2000.

		Average Growth (inches)	Average TUs/inch
Spring	April	0.489	31.0
	May	0.504	31.2
	June	0.341	64.9
Fall	October	0.364	49.3
	November	0.083	223.7
	December	0.057	339.4

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).

Winthrop NFH: Feeds from Moore-Clark are used throughout rearing. Guidelines for matching size of feed with size of fish come from a combination of the manufacturer's recommendations and trial and error, and are as follows:

swim-up - 570/lb	#0 Nutra Starter
570/lb - 300/lb	#1 Nutra Starter
300/lb - 150/lb	#2 Nutra Starter
150/lb - 100/lb	1.2 mm Nutra Fry
150/lb - 90/lb	1.5 mm Clark Fry
100/lb - 50/lb	2.0 mm Clark Fry
50/lb - 20/lb	2.5 mm Clark Fry

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.

Fish health is monitored by the Winthrop NFH staff. Monthly fish health checks are conducted by Olympia Fish Health Center personnel. All rearing units are cleaned on a regular basis to help prevent environmental fish health problems.

Health monitoring activities that normally take place at Winthrop NFH include the following:

- On at least a monthly basis, both healthy and clinically diseased fish from each fish lot are given a health exam. The sample includes a minimum of 60 fish per lot.
- At spawning, a minimum of 60 ovarian fluids and 60 kidney/spleens are examined for viral pathogens from each species.
- Prior to transfer or release, fish are given a health exam. This exam may be in conjunction with the routine monthly visit. This sample consists of a minimum of 60 fish per lot.
- Whenever abnormal behavior or mortality is observed, the fish health specialist will examine the affected fish, make a diagnosis and recommend the appropriate remedial or preventative measures.
- Reporting and control of specific fish pathogens are conducted in accordance with the Co-Managers Fish Disease Control Policy and the USFWS Fish Health Policy and Implementation Guidelines.

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.

When sampling fish at LNFH and Butcher Creek, we estimate the degree of smoltification by classifying pre-smolts as either parr, transitional, or smolt based on physical appearance. ATPase activity is not measured.

9.2.9) Indicate the use of "natural" rearing methods as applied in the program.

At Winthrop NFH, final rearing occurs in outside raceways and ponds. Coho are moved out to C-bank 12' x 100' raceways at 150-400 fish per pound in April or May. The fish occupy two ponds until marking or a DI of .20 is reached, at which time the groups are split to occupy 5 ponds until release—approximately one year after they are moved outside. Release is volitional and generally starts the third week of April and ends the first week of May. The target release size is currently 20 to 22 fish per pound.

Water source during final rearing is primarily river water. Ground water is usually available if needed to clear up disease problems or regulate growth rates. River water temperatures fluctuate according to air temperatures, but normally stay in favorable ranges throughout summer and winter months.

On years when egg take goals are not met, fish are often transported from lower Columbia River coho hatcheries to make up the number for a final release of 250,000 smolts. Successful transfers have taken place in late winter and early spring to allow an adequate acclimation period.

Release strategies may be modified by YN, but in recent years have been volitional type releases directly out of the rearing units. The large drains of C-bank lead under the hatchery grounds to a bypass channel which leads to the river.

Natural rearing conditions are emphasized during the acclimation/release phase (see section 10). Camouflage netting is used to provide semi-natural cover during most of the outdoor rearing cycle. Covers are not used during mid-winter months due to snow load problems. Also, temperature and feeding are manipulated to help match hatchery smolt

sizes and growth regimes to those of natural smolts. Other hatchery rearing technologies that produce a more natural-like smolt will be tested in the future. Options being considered include rearing in locations closer to acclimation sites, rearing in natural-style ponds, rearing at low densities, extending the acclimation period to include the second winter prior to smolting, and more culture adjustments to include very rapid growth just prior to release.

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation. No listed fish are propagated in this program.

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

10.1) Proposed fish release levels.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Yearling	751,500	19.2 (yr 2000)*	Volitional release, Apr 15 – May 30	Icicle Creek
Yearling	248,500	19.5 (yr 2000, at time of transport to site)*	Volitional release, Apr 15 – May 30	Nason Creek
Yearling	250,000	17.0 (yr 2000)*	Volitional release, Apr 25 – May 15	Methow River

* Source: K. Murdoch 2001

10.2) Specific location(s) of proposed release(s).

The following lists potential or approved release sites as of spring 2002. Others might be added in future years, depending on NEPA, ESA, TWG, and other reviews.

Stream, river, or watercourse: Nason Creek

Release point: Butcher Creek acclimation site, RM 8.2

Major watershed: Wenatchee River

Basin or Region: Mid-Columbia

Stream, river, or watercourse: Nason Creek

Release point: Early Pond acclimation site, RM 8.5

Major watershed: Wenatchee River

Basin or Region: Mid-Columbia

Stream, river, or watercourse: Nason Creek

Release point: Whitepine acclimation site, RM 11.2

Major watershed: Wenatchee River

Basin or Region: Mid-Columbia

Stream, river, or watercourse: Beaver Creek

Release point: Beaver Creek acclimation site, RM 0.5

Major watershed: Wenatchee River

Basin or Region: Mid-Columbia

Stream, river, or watercourse: Icicle Creek

Release point: Leavenworth NFH, Dam 5, RM 2.8

Major watershed: Wenatchee River

Basin or Region: Mid-Columbia

Stream, river, or watercourse: Little Wenatchee R.

Release point: Two Rivers, RM 0.5

Major watershed: Wenatchee River

Basin or Region: Mid-Columbia

Stream, river, or watercourse: Wenatchee R.

Release point: Brender, RM 2

Major watershed: Wenatchee River

Basin or Region: Mid-Columbia

Stream, river, or watercourse: Chumstick Creek

Release point: Uncertain [possible direct stream release]

Major watershed: Wenatchee River

Basin or Region: Mid-Columbia

Stream, river, or watercourse: Methow River

Release point: Winthrop NFH, RM 50.4

Major watershed: Methow River

Basin or Region: Mid-Columbia

10.3) Actual numbers and sizes of fish released by age class through the program.

Leavenworth NFH

Release year	Yearling	Avg size
1996	N/A	
1997	N/A	
1998	N/A	
1999	450,000	
2000	891,845	19.2
2001	855,167	19.5

Release year	Yearling	Avg size
Average	732,337	

Nason Creek

Release year	Yearling	Avg size
1996	N/A	
1997	N/A	
1998	N/A	
1999	50,000	
2000	76,893	19.5
2001	142,291	19.5
Average	89,728	

Methow River

Release year	Yearling	Avg size
1996	335,300	
1997	74,200	
1998	341,146	
1999	0.00	
2000	199,763	17.0
2001	260,319	19.0
Average	201,788	

Source: K. Murdoch, 2001.

10.4) Actual dates of release and description of release protocols.

Table 1 (section 1.11) shows release numbers from each release site in the Wenatchee and Methow basins. All fish were volitionally released as smolts. Release dates in the Methow ranged from April 25 – May 15; release dates in the Wenatchee ranged from April 15 – May 30. In the Wenatchee, snorkel surveys confirmed that all fish had left acclimation sites. The date volitional release begins is determined by observing the migratory behavior of the smolts.

The program ideal is to have sufficient numbers of progeny of local returns to allow progeny of returns to the Methow released in the Methow, and progeny of Wenatchee returns released in the Wenatchee. We have not yet reached that ideal. In the interim, because our data show that smolt-adult survivals are much higher for Wenatchee releases than Methow releases, we propose the following release guidelines, as the way to make the best possible use of the fish that have survived to the mid-Columbia:

- 1) Progeny of Wenatchee returns are released in the Wenatchee.
- 2) If there are insufficient smolts from Wenatchee returns to meet the 1 million release number in the Wenatchee, they will be supplemented with progeny of Methow returns. This could leave the Methow with a shortfall, so Methow releases would be supplemented, as necessary, with lower Columbia River stocks.
- 3) If there are still insufficient numbers to meet the 1 million release numbers in the Wenatchee, even with Methow progeny, they will be supplemented with lower Columbia River juveniles, in which case all releases in the Methow would be lower Columbia River stocks.
- 4) If there is extra production of Wenatchee progeny and a shortfall in the Methow, the extra Wenatchee fish could be used to make up the shortfall in the Methow.

10.5) Fish transportation procedures, if applicable.

Coho smolts are typically hauled by ODFW from lower Columbia River hatcheries to various acclimation ponds in mid-Columbia basins. Fish are transported in 1,500-5,000 gallon (6,000-19,000 liter) transport tanker trucks. These units are insulated and typically maintain sub-50°F (<10°C) hauling temperatures and strive for no more than a 10°F (6°C) (<5°F preferred) variation between tank temperature and release site temperature. Transport tanks are equipped with oxygen injection and water circulation systems. Dissolved oxygen levels are maintained at 9-15 ppm. Oxygen and temperature levels are monitored during transports. Hauling densities are targeted at or below 1 pound of fish per gallon of water. Length of transport ranges from 6 to 8 hours.

10.6) Acclimation procedures (*methods applied and length of time*).

To condition them to the wild, coho smolts are acclimated away from the hatchery whenever possible in a semi-natural rearing environment. These sites use surface water supplies that expose fish to cold water early in the acclimation period and a rising temperature as the release time approaches. Ponds usually have earth and rock bottoms, and surrounding natural vegetation provides some cover. A low level of predation by fish, birds, and mammals will be allowed.

Juvenile coho are typically acclimated for 4-6 weeks prior to liberation, but depending on experimental objectives, could be acclimated from 2 weeks to 6 months. During that period, fish culturists periodically feed the pre-smolts a predetermined amount of fish food. This amount is calculated based on number and size of fish, and on water temperature. Typical fish culture activities include net and screen maintenance; pond cleaning (if applicable); predator control using such methods as nets, non-lethal live traps, propane and other noise emitters; mortality assessments; and growth and fish health measurements.

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

In 2000, 26,394 of the 925,000 coho released from Icicle Creek were coded wire tagged and adipose-fin-clipped; 26,118 were coded wire tagged with no external mark. No Butcher Creek fish were marked or tagged. Of the 200,000 coho smolts released from Winthrop in 2000, 26,470 were coded wire tagged and fin-clipped. By 2002, 100% of the hatchery population will be internally marked with a coded wire tag. The current marking protocol is outlined in Table 19 (section 11.1.1). Fish marked with CWT are not adipose clipped in order to limit their harvest in selective fisheries that target adipose-clipped coho (see section 3.3). Since the program's emphasis during the feasibility studies is development of a localized coho broodstock, the program will attempt to maximize the number of adults collected, thereby allowing the project to estimate relative survival between mark groups by evaluating tags recovered from fish collected for broodstock. We expect natural coho production to be relatively low since we will attempt to collect a large proportion of the return. However, we will attempt to estimate the number of naturally produced fish by estimating the relative proportion of unmarked juvenile and adult fish, thereby providing a means to estimate the smolt-to-adult rates for both hatchery and naturally produced coho.

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

Not applicable. The program has no surpluses at this time.

10.9) Fish health certification procedures applied pre-release.

Fish health experts check the condition of fish prior to removal from the hatcheries (described in 9.2.7). Health checks are not performed at the acclimation sites unless obvious signs of disease are present.

10.10) Emergency release procedures in response to flooding or water system failure.

In the event of flooding, coho would be released early from acclimation ponds. Sites are designed to allow safe fish migration during floods. High-water exit paths are included near stream channels so that if ponds are overtopped during floods, fish can leave volitionally. Premature releases might reduce coho survival if they were not ready to migrate, but high water likely would move them rapidly downstream in turbid water, providing little opportunity for them to prey on other species or to be preyed upon themselves.

In the past, Winthrop NFH's water system has occasionally frozen in winter, requiring release of fish. The hatchery plans to install a new infiltration gallery, reducing the likelihood that coho would be released prematurely; however, unforeseen disasters such as freezing or pump failures could still result in emergency releases of fish (C. Pasley, personal communication, July 2002).

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

Most resident trout and steelhead are not considered to be at risk because these species generally emerge from the gravel after coho have migrated downstream, or spawn in upper reaches of tributaries (i.e., bull trout).

Studies in these basins have shown little evidence of hatchery coho predation on spring chinook, possibly because coho smolts migrate rapidly once they are released. However, because of the nature of the project, biologists need to deliberately create some risk to listed or sensitive fish in order to test the degree to which coho predation on other species might occur if coho are

reintroduced. These risks are minimized by implementing the following measures as appropriate:

- working with other fish managers to determine release sites and numbers that minimize risk but that also meet research objectives;
- releasing coho smolts in low densities;
- attempting to release fish that more closely resemble sizes of wild coho, which tend to be smaller than hatchery fish² (our target size of 20-25 fpp equates to 110 – 120 mm).
- ensuring smolts are ready to migrate before releasing them volitionally; and
- monitoring predation and adapting feasibility studies and activities as necessary to minimize risks.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

The studies listed below would be conducted in the Wenatchee, Methow and Yakima basins. Currently, direct predation studies are proposed only in the Wenatchee basin, although studies likely would be needed in the future in other basins.

Funding for this feasibility project is being provided by Bonneville Power Administration. The research is being implemented by the Yakama Nation, with assistance from other project participants.

11.1.1) Describe plans and methods proposed to collect data necessary to respond to each “Performance Indicator” identified for the program (section 1.10).

Performance Indicator: Trends in survival of hatchery coho as measured by smolt-to-smolt (PIT tags) and smolt-to-adult (counts at dams/facilities) survival.

The smolt-to-smolt and smolt-to-adult survival rates for hatchery coho released in the Wenatchee and Methow basins would be studied in three ways.

- To estimate smolt-to-smolt survival to McNary Dam and other lower Columbia River mainstem projects, a portion of each release group (at least 8,000 fish annually in the Wenatchee, 8,000 every third year in the Methow) would be PIT-tagged (see “Marking” below).
- Smolt-to-adult survival would be monitored for the Wenatchee basin based on Rock Island minus Rocky Reach and/or Dryden Dam adult fish passage counts and redd counts. They would be based on Wells Dam counts for the Methow basin.

² Throughout the geographic range of coho salmon, length at smoltification is relatively consistent. Groot and Margolis (1991) reported that mean smolt size in yearling smolts ranged from 75 (Andersen and Narver 1975) to 122 mm fork length (McHenry 1981), and smolt size in Minter Creek, Washington ranged from 95-106 mm (Salo and Bayliff 1958).

- Coded wire tags would be collected from all coho retained for broodstock and from carcasses collected during spawning ground surveys to allow for a comparison in smolt-adult survival rates between acclimation sites and local vs. lower river stocks.

Marking

The marking protocol to estimate the smolt-to-adult survival rate for coho juveniles released in the Wenatchee system is outlined in Table 19. Three internal-mark groups will be identified: lower Columbia River transfers, Wenatchee progeny and Methow returning progeny. Each mark group will receive a differential CWT code. All CWT marks will be snout tags and potentially alternate body tag locations (for example dorsal, anterior fins, cheek, etc.). Adipose fin clips will not accompany CWT marks. In 2001-2002, an unmarked group (Lower River returns) will be identified by subtraction (total returns collected minus marked returns). Beginning in 2002, all three mark groups of juvenile coho released in the Wenatchee will be marked with CWT. If it is determined that selective mating of in-basin vs. Lower River progeny will occur, then body tag locations will be added in order to non-lethally differentiate mark groups. All marks will be retrieved from spawned broodstock and spawning ground carcasses in order to estimate survival by group.

The project will use PIT-tagged juveniles in order to parse out that portion of the smolt-to-adult mortality that is occurring in the freshwater migrant lifestage. Mark groups identified are lower Columbia River transfers, Wenatchee progeny and Methow returning progeny. PIT-tagged juvenile coho were released in the Methow in 2000 and 2001 (Table 20). This will give us two consecutive years of juvenile survival from the Methow for Lower River smolts. PIT tag releases from that point will occur approximately every third year (Table 20), unless mainstem passage conditions change, or other conditions occur to make us suspect survival rates may have changed.

PIT-tagged juveniles will be released in the Wenatchee River every year until at least 2005 (Table 21). The project PIT tagged and released 8,000 fish in 2000 and 2001 in order to establish a baseline juvenile survival rate for Lower River coho smolts. In 2002, the project released 8,000 coho juveniles from the Leavenworth Dam 5 site, in addition to 8,000 Wenatchee progeny from the natural production areas, in order to assess differences in juvenile survival between the two groups. During the period 2004-2005, the project will release 8,000 PIT-tagged Wenatchee progeny in the natural production areas to monitor changes in juvenile survival potentially related to the local adaptation process.

Marking Protocol for the Mid-Columbia Coho Releases

Table 19. CWT Marking Scheme* for Mid-Columbia Coho Smolt Releases

Release Year	Lower River Transfers Methow	Lower River Transfers Wenatchee	Wenatchee Progeny	Methow Progeny
2001	100% (250,000)	0% (826,600 not marked)	N/A	100% (146,875)
2002	100% (250,000)	100% (678,524)	N/A	N/A

2003	100% (if used)	100% (if used)	100%**	100%**
2004	100% (if used)	100% (if used)	100%**	100%**
2005	100% (if used)	100% (if used)	100%**	100%**

* Marks will be differential CWT (snout and potentially cheek) with no adipose fin clip.

** Actual numbers will depend on numbers produced, which is unpredictable at this time.

Table 20. PIT Tag Releases of Juvenile Coho from the Methow Basin

Release Year	Lower River Transfers
2000	8000
2001	8000
2002	0
2003	0
2004	8000*
2005	0

*Numbers depend on funding.

Table 21. PIT Tag Releases of Juvenile Coho from the Wenatchee Basin

Release Year	Lower River Transfers	Wenatchee Progeny	Methow Progeny
2000	8000	N/A	N/A
2001	8000	N/A	0
2002	8000	17,000*	0
2003	0**	24,000*	0
2004	0**	24,000*	0
2005	0**	24,000*	0

* Numbers depend on funding.

**A sample will be PIT tagged, if Lower River fish are used.

Performance Indicator: Spatial distribution of returning adults in potential natural spawning areas as identified from radio telemetry and foot/boat redd surveys.

Foot/boat redd surveys are conducted in the Wenatchee basin in several areas where adult coho are expected to spawn naturally (Nason Creek, Icicle Creek, and in the Little Wenatchee and Wenatchee rivers. In some of the smaller streams (Chumstick, Beaver, Brender), we might rely on weirs or traps to determine how many fish are returning to these streams. The Methow River is also surveyed.

Beginning in 2001 and continuing in 2002, the Yakama Nation is conducting a radio-telemetry evaluation to estimate the proportion of coho returning to the Wenatchee River that spawn in Beaver and Nason Creeks. Up to 75 adult coho randomly collected at the Tumwater Dam fish trap are anesthetized, gastrically tagged and released upstream of the dam. Fixed monitoring stations near the mouths of Nason and Beaver creeks determine how many of the tagged fish spawned in each creek. Mobile tracking determines the spawning locations of the tagged fish. Data are corroborated with spawning ground surveys. Video counts are used to estimate the total number of fish spawning above Tumwater Dam (Beaver Creek and Nason Creek). In 2004, the study will include adults spawning in the Little Wenatchee River.

The Yakama Nation conducts weekly spawning ground surveys in Nason Creek and bi-weekly surveys in Icicle Creek to identify the location and distribution of coho redds. Surveys began in fall 2001 and are conducted between about October 15th and December

15th. Surveys may extend beyond December 15th if spawning is not complete and river and weather conditions permit.

In Nason Creek, researchers attempt to count all coho redds. The surveys extend from Whitepine Creek (RM 15.4) to the mouth of Nason Creek (RM 0). The entire length of Icicle Creek below the hatchery (2.8 miles) is also surveyed. Elsewhere, surveys are conducted initially in stream reaches close to the smolt release sites, and branch out from these release sites if redds are not located; or researchers use radio telemetry results to guide them to likely spawning locations. Staffing and funding do not allow the entire basin to be searched for every coho redd.

Each redd identified is marked with a piece of surveyors tape. Locations of each redd are identified and mapped with a portable GPS unit. We also collect spawned coho carcasses during the surveys. From each coho carcass found, fork length and post-orbital hypural length are measured to the nearest millimeter. The sex is identified. The percentage of eggs remaining in each female coho carcass is visually estimated.

Physical data are recorded from a random sample of redds in each sub-basin.

Performance Indicator: Reproductive success (initial evaluations only) of naturally reproducing coho using redd counts, redd capping, and smolt production estimates.

Redd count methods are described in the previous section. The smolt production estimate comes from the Monitor smolt trap, operated by WDFW. Redd capping (placing a fine mesh net over the redd and capturing emerging fry in the cod end) is also done in selected areas.

Performance Indicator: Changes made by out-of-basin stock, using genetic monitoring of neutral allelic frequencies; and recording of such traits as fecundity, body morphometry, maturation timing, and straying/homing rates.

The genetics sampling and adaptation program would study:

- the naturalization of a hatchery fish stock (Lower Columbia River stock);
- allelic frequencies to determine the amount and rate of divergence of the mid-Columbia broodstock from the Lower River stock;
- physical traits and demographic information for introduced coho juveniles and adults and the contribution of those traits and other characteristics to survival.

The main goal driving the genetic and adaptation monitoring and evaluation is to determine the best implementation strategies that result in enhancing the natural production of coho salmon in mid-Columbia rivers. The genetic and adaptation M&E plan focuses on three major categories: 1) are there changes in the frequencies of neutral alleles in the population over time as the program and broodstock develop; 2) is there phenotypic divergence of localized coho and Lower River hatchery coho; and 3) are the introduced fish successful at producing progeny?

The following subsections describe the specific program for each of the genetic and adaptation monitoring studies listed above.

- *Assess changes in out-of-basin stock using genetic monitoring of allelic frequencies.*

The main opportunity of the genetics M&E program is to determine the rate and direction of divergence in neutral allele frequencies of the coho stocks that are used for reintroduction in mid-Columbia rivers.

A sound understanding of the genetic structure of the species of interest is a prerequisite to the assessment of the genetic impacts of human activities such as introductions, transfers or stock enhancement on natural populations. A measure to assess the impact of human activities on natural populations is the degree to which the population structure responds to applied management actions. This can be done by measuring the frequencies of alleles at specific loci through time and in a series of populations (Allendorf and Phelps 1981; Utter 1991; Allendorf 1995). Such a database permits the determination of temporal (and mostly stochastic) and geographic (degree of isolation) variance components. A series of samples will be taken of naturalized coho spawning in the wild (Naches and Upper Yakima Rivers), as well as from the Yakima, Wenatchee, and Methow hatchery broodstocks. An additional number of samples will be used to scale the level of variability within and beyond the Columbia River populations (Umatilla, Clearwater, Klickitat, Lower Columbia, and the Thompson River on the Fraser River system). Microsatellite DNA techniques will be the primary tool. Protein electrophoresis and mtDNA may also be used.

- *Monitor traits such fecundity, body morphometry, and maturation timing.*

Because conditions in the mid-Columbia and Yakima are likely to be different than in the coastal streams and lower Columbia where the coho originate, life history characteristics of the introduced broodstock are likely to change. For one, the migration distance is very much greater into the mid-Columbia than, for example, to Eagle Creek. Optimal maturation rates and timing are likely to be different between these two areas. In order to determine if the stock used has adequate genetic variance and phenotypic plasticity to adapt to local conditions, the life history characteristics of the coho broodstock must be monitored over the length of the program.

An important link to environmental condition is the water temperature profiles in the streams or hatchery setting. The coho stock will be exposed to a water temperature profile that may deviate from the ancestral stream. Although this does not represent a particular problem for controlled conditions (there is generally very little variation in development rate of the eggs, and the genetic variance is additive), it is necessary to determine if the broodstock used has sufficient variance in maturation schedules to match local conditions. A longer-term goal is to select the broodstock from successful wild-spawning fish, thereby enabling the broodstock to progress towards local maturation optima.

For this plan, we will monitor fitness-related phenotypic traits such as fecundity, body morphometry, and maturation timing.

- *Gene flow from program fish into natural populations.*

Monitoring done on mid-Columbia coho will contribute to answering broader questions about the rate of genetic drift when a broodstock is established in a subbasin. A regional sampling effort will collect samples of coho from all reintroduced populations (programs

with the intent of establishing wild-spawning, self-recruiting populations) above Bonneville Dam. These samples will be used to extract alleles at a number of nuclear DNA loci. These will be used to estimate parameters of gene flow, diversity, and genetic differentiation.

- *Quantify stray rates and homing to acclimation sites.*

As shown in Table 1b, 1,773 adult coho returned to the Wenatchee basin in 2001. The Fish Passage Center indicates that 10,465 and 1,628 adult coho were counted at Rock Island and Rocky Reach dams, for a difference of 8,837 adults (M. Cooper, USFWS letter, July 1, 2002). Such results raise questions of what happens to the coho between these dams and the smolt release sites to which they would be expected to return.

1) The project will investigate straying and drop-out rates of transferred hatchery coho within the mid-Columbia basin. A sample size of up to 400 adult coho returning to mid-Columbia tributaries will be radio-tagged at Priest Rapid Dam. A combination of fixed sites and mobile tracking will be used to identify spawning areas, drop-out rates, and stray rates. We will also recover CWTs from all carcasses during spawning surveys in order to recover release group information. We will also coordinate with other fisheries agencies within the basin to aid in the recovery of marks to evaluate homing/stray rates.

2) The project also will investigate the rates at which transferred hatchery coho stray back to their natal hatcheries. All fish collected for broodstock at the lower Columbia River hatcheries are examined for the presence of a CWT regardless of the presence or absence of an adipose fin. Spawning surveys conducted by state and federal agencies in the vicinity of lower Columbia River hatcheries also check carcasses for the presence of CWT regardless of the presence of an adipose fin, and enter data into existing regional databases.

Performance Indicator: Predation on other species by program fish as measured by stomach content analyses.

Currently, studies of predation by hatchery coho on sensitive species are planned only for the Wenatchee River basin. Predation studies would not be done in the Methow basin primarily because the opportunities don't exist to study predation on the species of concern—spring chinook, sockeye, and steelhead. All returning spring chinook adults in the Methow are collected and taken to the hatchery to be spawned under an adult-based supplementation program. Studies of hatchery coho predation on steelhead are not planned because steelhead emerge after yearling coho have migrated.

A rotary trap would be placed near two coho acclimation/release sites in the Wenatchee basin to monitor the level of predation on spring chinook and sockeye fry by coho smolts. The stomach contents of up to 3,000 coho would be examined for each of two studies (one of coho predation on spring chinook, the other of coho predation on sockeye) (6,000 fish total).

- *Predation on spring chinook*

Methods are detailed in Mid-Columbia Coho Reintroduction Feasibility Study 2002/2003 F2 Study Plans (prepared by Keely Murdoch, YN):

Hatchery coho smolts released from acclimation sites on Nason Creek and naturally reared coho smolts scatter planted in Nason Creek approximately 9 months prior to the predation evaluation will be recaptured in a 5-foot rotary screw trap located at RK 1.3 on Nason Creek (Nason creek Campground). The trap will be operated between March 15 and June 15. The naturally reared coho will be marked with an adipose fin clip for quick identification.

The rotary smolt trap will be checked and the live box emptied hourly during the study. The frequent removal of coho from the trap is important in minimizing predation on chinook fry within the live box. Up to 1500 hatchery coho smolts and 1500 naturally reared coho smolts will be collected from throughout the run and retained for stomach content analysis, which will use methods similar to those used in previous years and documented in the 2001 annual report for the project (Murdoch and LaRue 2002).

- *Predation on sockeye*

A brief literature review of the life history of sockeye salmon indicates that they vary substantially in age at out-migration, in growth, and in rearing habitats throughout their geographic range (Groot and Margolis 1991). Such variation makes species-wide generalization difficult. Before attempting a study of coho predation on sockeye, life history information specific to Lake Wenatchee must be collected, in order to determine periods and locations that sockeye salmon in Lake Wenatchee are most susceptible to hatchery coho smolt predation. Sockeye life history collection began in 2001, with limited results; methods will be modified in 2002 as described below.

The YN used radio telemetry to estimate hatchery coho smolt spatial distribution within and travel time through Lake Wenatchee. Due to the short tag life of smolt-sized radio-transmitters (10 days), the data we gathered were limited—many of the tags died before the smolts left the lake. Of the fish we were able to track through the lake, mean travel time was 6.85 days. Telemetry technology is changing rapidly. During the 2002 spring emigration, a smolt-sized radio tag will be available with a tag life of approximately one month. This will allow a more complete data set to be collected.

We used snorkel surveys and beach seining to locate sockeye fry within the littoral zone of Lake Wenatchee. The first fry were observed on May 11 and were observed in the littoral zone from this point through the end of the study. Tow nets were used to capture sockeye fry in the limnetic areas of the lake. Only two fry were captured in the limnetic zone, both on May 16th. The size of the tow net may have been limiting. A larger tow net will be used in 2002 to more accurately assess the locations and distribution of sockeye fry during late April and May.

At the end of the data gathering period (2002), we will assess the information and determine potential risk to sockeye from coho predation and also the potential for monitoring success. If it is considered feasible to continue the study and coho are released upstream of the lake, YN would monitor the impact through a predation study similar to those done for spring chinook, possibly using a WDFW rotary trap at the Lake Wenatchee outfall, or beach seining or trawling in Lake Wenatchee.

Performance Indicator: Superimposition of spring chinook redds by spawning coho as measured by superimposition studies.

Due to concerns regarding the number of adult coho spawners returning to Nason Creek in 2001 and 2002, and possible superimposition effects on incubating spring chinook salmon eggs by later spawning coho salmon, the YN is monitoring the locations of spring chinook redds, identified by CPUD, and coho salmon spawning locations to gauge the potential for redd superimposition and associated adverse effects.

In 2001 we measured the exact locations of up to 50 spring chinook redds in each of two study reaches (100 total) in Nason Creek (Table 22). Each study redd was measured by triangulating from the upstream and downstream ends of the redd tailspill with two fixed points on the bank. The width of each study redd was measured at its widest point.

These measurements enabled us to accurately determine superimposition by spawning coho salmon on spring chinook redds. Each redd was relocated during coho spawning ground surveys and the percent of superimposition was visually estimated (0 through 100%).

During the 2001 coho spawning ground surveys, three coho redds were identified in Nason Creek. None was found to superimpose on spring chinook redds.

The studies will be continued in future years.

Table 22. Redd Superimposition Study Reaches

Reach	Location	River Mile	Length	% of 2000 chinook spawning
Butcher Creek	Butcher Creek Pond to Butcher Creek Rd. Bridge	8.3 to 7.1	1.2 RM	14%
Lower Nason	Fishing Pond to Campground	3.4 to 0.8	2.6 RM	16%

Performance Indicator: Competition for food and habitat during freshwater rearing of naturally produced coho juveniles as measured through micro-habitat use and growth evaluations.

To begin to evaluate the potential for naturally produced coho salmon to negatively affect steelhead or spring chinook salmon through competition for space and food, we will assess the distribution, habitat use, growth and abundance of juvenile steelhead and spring chinook in the presence and absence of coho. Potential micro-habitat overlap between sub-yearling coho, spring chinook, and steelhead will be evaluated every two weeks between July 1st and September 15th, beginning in 2002. For the analysis, Nason Creek will be divided into 4 study reaches. Two reaches will be located upstream of the Butcher Creek acclimation site, and two will be located downstream of the site. This division of reaches was selected because the distribution of spring chinook redds identified during spawning ground surveys in 2000 indicated that 52% of the chinook spawned between the Butcher Creek acclimation

site and Whitepine Creek, while 48% spawned downstream from the Butcher Creek acclimation site (Mosey and Murphy 2000). Within the four reaches we will snorkel a stratified random sample of habitat to collect information regarding microhabitat use and distribution of chinook, steelhead and coho.

Due to the low number of coho redds in Nason Creek in 2001, hatchery coho parr from mid-Columbia broodstock will be scatter planted into two of four study reaches in 2002 (treatment reaches). The four study reaches are listed in Table 1. While the scatter-planted coho salmon are not naturally produced, we propose to use them as a surrogate, providing information regarding possible interactions between juvenile coho and species of concern.

Prior to scatter planting sub-yearling coho, the current, or baseline, distribution of 0+ spring chinook and steelhead will be evaluated, using the four reaches shown in Table 23. Each reach will be divided into 500 meter sections. We will randomly select 100 meters from each 500-meter section for distribution analysis through underwater observation (20% sample rate). Underwater snorkeling techniques will be conducted as described by Thurow (1994). All salmonids will be enumerated by species and size class. Macrohabitat (pool, riffle, or glide) will be noted and measured. Fish densities and distribution will be reported.

Table 23. Nason Creek Study Reaches

Reach Number	Location	Coho Scatter Plants	River Kilometer
1	Mouth to Kahler Creek Bridge	Yes	0.0 to 6.3
2	Kahler Creek Bridge to Butcher Creek	Yes	6.3 to 13.3
3	Butcher Creek to Merritt Bridge	No	13.3 to 17.9
4	Merritt Bridge to Whitepine Creek	No	17.9 to 24.8

Prior to scatter planting, baseline collections of fish for growth and condition factor information will be collected. Fish growth and condition factor sampling will be repeated once a month for two months.

Within each reach we will collect a sample of up to 25 sub-yearling chinook, steelhead, and coho using a back-pack electrofisher. After collection fish will be anesthetized, measured (fork length in mm), and weighed. Condition factors will be calculated for each fish examined. Micro-habitat variable, abundance and condition factors of spring chinook and steelhead collected in allopatry and sympatry with coho will be compared using analysis of variance.

Comparisons in the change in growth will be made between chinook and steelhead parr in reaches 1 and 2 (sympatric with planted coho [treatment]) with the change in growth and condition factors for chinook and steelhead located in reaches 3 and 4 (allopatric with planted coho [control]).

Performance Indicator: Other potential ecological interactions as indicated by residualism surveys or F2 evaluations.

- *Residualism surveys*

Snorkeling surveys following a stratified random sampling design were done near acclimation/release sites to determine whether and how many coho do not migrate downstream after release. Few residual coho have been found (see section 3.5.3) and no further studies are proposed.

- *Other F2 evaluations*

Additional studies of interactions between naturally produced coho and other fish species—particularly listed fish—are anticipated when and if there are sufficient numbers of coho to allow a meaningful study to be conducted. Methods will be developed in consultation with the TWG.

11.1.2) Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.

Project budgets have been approved by NPPC and BPA through 2005.

11.2) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.

Some risk to sensitive species needs to be imposed in order to study the potential for long-term risk from coho reintroduction. Sections 3.5.3 and 10.11 list mitigation measures that would minimize the risk to listed species from coho releases.

During all monitoring and evaluation activities, any listed fish incidentally caught or handled will be released immediately to the location from which it was caught. During the operation of a rotary smolt trap, risk to listed fish can be minimized by frequent checking and emptying of the trap's live box. Experience has shown little or no mortality from broodstock collection procedures, as listed fish not subject to collection themselves are released upstream immediately. Risk of mortality from electro-shocking is reduced by using properly trained personnel and following NMFS guidelines for electro-shocking (NMFS 1998(a)) and additional guidance in Fredenberg 1992.

SECTION 12. RESEARCH

Because the Mid-Columbia Coho Reintroduction Feasibility Project is by definition a research project, there are no additional studies or descriptions to add to this section beyond what is covered in section 11.

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

“I hereby certify that the foregoing information is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973.”

Name, Title, and Signature of Applicant:

Certified by_____ Date:_____

APPENDIX A: TAKE TABLES

Listed species affected: <u>Spring Chinook</u> ESU/Population: <u>UCR</u> Activity: <u>Smolt Trapping</u>				
Location of hatchery activity: <u>Nason Creek</u> Dates of activity: <u>3/15 – 6/15</u> Hatchery program operator: _____				
	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	500	1000		
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)	10	20		
Other Take (specify) h)				

Listed species affected: <u>Steelhead</u> ESU/Population: <u>UCR</u> Activity: <u>Smolt Trapping</u>				
Location of hatchery activity: <u>Nason Creek</u> Dates of activity: <u>3/15 – 6/15</u> Hatchery program operator: _____				
	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)		500		
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)		10		
Other Take (specify) h)				

Listed species affected: <u>Bull Trout</u> ESU/Population: <u>UCR</u> Activity: <u>Smolt Trapping</u>				
Location of hatchery activity: <u>Nason Creek</u> Dates of activity: <u>3/15 –6/15</u> Hatchery program operator: _____				
	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)		25		
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)		1		
Other Take (specify) h)				

Listed species affected: <u>Spring Chinook</u> ESU/Population: <u>UCR</u> Activity: <u>Electrofishing</u>				
Location of hatchery activity: <u>Nason Creek</u> Dates of activity: <u>7/1-9/30</u> Hatchery program operator: _____				
	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)		150		
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)		15		
Other Take (specify) h)				

Listed species affected: <u>Steelhead</u> ESU/Population: <u>UCR</u> Activity: <u>Electro-fishing</u>				
Location of hatchery activity: <u>Nason Creek</u> Dates of activity: <u>7/1-9/30</u> Hatchery program operator: _____				
	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)		150		
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)		15		
Other Take (specify) h)				

Listed species affected: <u>Bull Trout</u> ESU/Population: <u>UCR</u> Activity: <u>Electro-fishing</u>				
Location of hatchery activity: <u>Nason Creek</u> Dates of activity: <u>7/1-9/30</u> Hatchery program operator: _____				
Type of Take	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)		10	3	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)		10	3	
Other Take (specify) h)				

Listed species affected: <u>Steelhead</u> ESU/Population: <u>UCR</u> Activity: <u>Broodstock Collection</u>				
Location of hatchery activity: <u>Dryden Dam</u> Dates of activity: <u>9/1-12/7</u> Hatchery program operator: _____				
Type of Take	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)			30	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: <u>Bull Trout</u> ESU/Population: <u>UCR</u> Activity: <u>Broodstock Collection</u>				
Location of hatchery activity: <u>Dryden Dam</u> Dates of activity: <u>9/1-12/7</u> Hatchery program operator: _____				
Type of Take	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)			2	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: <u>Steelhead</u> ESU/Population: <u>UCR</u>				
Activity: <u>Trapping – Radio-telemetry and/or broodstock collection</u>				
Location of hatchery activity: <u>Tumwater Dam</u> Dates of activity: <u>9/1/-12/7</u> Hatchery program operator: _____				
	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)			30	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: <u>Bull Trout</u> ESU/Population: <u>UCR</u> Activity: <u>Trapping – Radio-telemetry and/or broodstock collection</u>				
Location of hatchery activity: <u>Tumwater Dam</u> Dates of activity: <u>9/15-12/7</u> Hatchery program operator: _____				
Type of Take	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)			2	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: <u>Steelhead</u> ESU/Population: <u>UCR</u> Activity: <u>Trapping-Radio-telemetry</u>				
Location of hatchery activity: <u>Priest Rapids Dam</u> Dates of activity: <u>9/15-12/7</u> Hatchery program operator: _____				
Type of Take	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)			50	
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: <u>Bull Trout</u> ESU/Population: <u>UCR</u> Activity: <u>Tow-net sampling</u>				
Location of hatchery activity: <u>Lake Wenatchee</u> Dates of activity: _____ Hatchery program operator: _____				
Type of Take	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)				
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: <u>Spring Chinook</u> ESU/Population: <u>UCR</u> Activity: <u>Weir Operation</u>				
Location of hatchery activity: <u>Beaver Creek</u> Dates of activity: <u>3/15 – 6/1; 9/1 – 12/15</u> Hatchery program operator: _____				
Type of Take	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	0	0	0	0
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: <u>Steelhead</u> ESU/Population: <u>UCR</u> Activity: <u>Weir Operation</u>				
Location of hatchery activity: <u>Beaver Creek</u> Dates of activity: <u>3/15 – 6/1; 9/1 – 12/15</u> Hatchery program operator: _____				
Type of Take	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	0	150	15	0
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)	0	5	0	0
Other Take (specify) h)				

Listed species affected: <u>Spring Chinook</u> ESU/Population: <u>UCR</u> Activity: <u>Weir Operation</u>				
Location of hatchery activity: <u>Brender Creek</u> Dates of activity: <u>3/15 – 6/1; 9/1 – 12/15</u> Hatchery program operator: _____				
Type of Take	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	0	0	0	0
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: <u>Steelhead</u> ESU/Population: <u>UCR</u> Activity: <u>Weir Operation</u>				
Location of hatchery activity: <u>Brender Creek</u> Dates of activity: <u>3/15 – 6/1; 9/1 – 12/15</u> Hatchery program operator: _____				
	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	0	200	20	0
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)	0	5	0	0
Other Take (specify) h)				

Listed species affected: <u>Spring Chinook</u> ESU/Population: <u>UCR</u> Activity: <u>Weir Operation</u>				
Location of hatchery activity: <u>Chumstick Creek</u> Dates of activity: <u>3/15 – 6/1; 9/1 – 12/15</u> Hatchery program operator: _____				
Type of Take	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	0	0	0	0
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)				
Other Take (specify) h)				

Listed species affected: <u>Steelhead</u> ESU/Population: <u>UCR</u> Activity: <u>Weir Operation</u>				
Location of hatchery activity: <u>Chumstick Creek</u> Dates of activity: <u>3/15 – 6/1; 9/1 – 12/15</u> Hatchery program operator: _____				
Type of Take	Annual Take of Listed Fish By Life Stage (<i>Number of Fish</i>)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)	0	200	20	0
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)	0	5	0	0
Other Take (specify) h)				